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JOURNAL
OF
CYCLE
RESEARCH

Vol. 2 No. 3

SUMMER 1953

JOURNAL OF CYCLE RESEARCH

LEONARD W. WING, EDITOR

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The Journal of Cycle Research is published quarterly at 9 E 77th St., New York 21, N. Y., by

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EDITORIAL

Along Cycle Trails

THE homesteaders traveling over the great Overland Trail found it literally littered with bones of horses and oxen or the remains of wagons abandoned at the trail side. Realities and time deal harshly with the traveler, whether a settler along a trail of history or an idea along a trail of science. The remains beside the Overland Trail spelled failure. Those beside the trails of science may spell some success. As it is success for science to know what does happen, so also it is success to science to know what does not happen. It is thus also in the relatively new field of cycle research. Many ideas have fallen by the wayside, yet others in faltering may show what does not happen.

Cycle research must examine, analyze, and evaluate records. Hence, long records are essential. Needed also are long range programs for testing and measuring cycles and their actions. The complexity of the problem and the length between phases of even the short cycles makes a program indeed a long one. A fur company wishing to learn the causes and workings of the 9.6-year cycle would have to set up a ten-year program to follow through one sequence afield. Shorter cycles repeat in shorter times and study of a five-year cycle would fit into a five-year plan. Into this would fit half a 9.6-year cycle and all cycles shorter than five years. With any program, whether a long-range one or something shorter, results come only by slow, methodical, painstaking plodding along. Results are not at the end of an overnight jaunt.

Just as the enthusiasm of many a pioneer waned or just as the starting courage ran out, so also has many a start in cycles been abandoned early. The pathways to knowledge of meteorological and climatological principles are noted for their ruggedness. They cannot be traveled on foam rubber. With few exceptions, attempts to study climates or meteorological cycles have sooner or later given up in favor of more secure and seemingly more profitable studies. Could it be that the trail was deserted by its travelers too soon?

CYCLES OF EUROPEAN PARTRIDGE ABUNDANCE

BY LEONARD W. WING

PARTIAL analysis of a bag record (1727-1909) of the European Partridge (*Perdix,perdix*) at Krumau (Czecho-Slovokia) reveals an alpha cycle 22.71 years long with an amplitude of 145.5% of trend at the high and 68.7% of trend at the low. Other cycles found and measured for length, amplitude, and timing are 13.95, 11.84, 8.33, 8.05, 5.09, and 4.14 years. A record (1793-1933) from Norfolk (England) has many irregularities that make analysis difficult, but one cycle has been measured and found to be 12.25 years in length and with an amplitude of 138.77% of trend at the high and 72.2% of trend at the low. Many additional cycles are indicated as present in both records. The paper describes methods of analysis in simple terms.

Introduction

In 1935, Professor Aldo Leopold of the University of Wisconsin returned from Germany with a record of game kill (1729-1909) on an estate near Krumau in Old Bohemia. He tossed them on my desk and remarked, "These should show something of cycles." An analysis of the records has been delayed, though I had expected to have done it soon after receiving the figures. This report is far from a complete analysis. I hesitate to suggest how many cycles may be present in the records, but the Krumau Partridge series may have several times the number described here.

The steps necessary to prepare a record for analysis have been described earlier and need not be repeated here, save as a review may aid in supporting the intent of the previous paper to present an exposition of analytic methods.* The records of the game bag were first converted to logarithms by use of a graphical table of logarithms.**

European Partridge at Krumau

Because the record for the year of 1730 was missing, a figure was supplied by averaging 1729 and 1731 and using this average for 1730 (Table 1). It seems entirely proper to use an interpolation, for it introduces no distortion of cyclical action.

An inspection of a graph of the logarithms (or a graph of the original figures) indicates well-marked areas of high centering at about 1751, 1770, 1792, 1814, 1837, 1862, and 1886 that lie between areas of low centering at about 1733, 1758, 1782, 1803, 1826, 1851, 1872, and 1896. The average of the six intervals between highs as measured between terminal crests of 1751 and 1886, is 22.5 years. The similiar average for the seven intervals between lows is 23.3 years. Hence, we may suspect the presence of an *alpha cycle* having a length longer than twenty-two years. It is clear enough to suggest this as the place to begin cycle analysis.

A time chart of the logarithms of numbers suffers from difficulty in determining clearspan values because of the rapid upward trend of the graph. Just what has caused the trend is difficult to say, but the development of superior guns no doubt played a part.

Because the nearest odd length to these measures of a possible alpha cycle is 23-years, I made a 23-year moving average of the logarithms and obtained the deviations from it (Table 1, Figures 1 and 2). The twenty-three year length moving average presents many advantages over any other length. Being an odd length, the average of each twenty-three years can be centered in a calendar position in the computation tables as well as on graphs. The twenty-three years will always center on the twelfth position. Twenty-three years being almost equal to the length of the apparent alpha cycle, nearly all of the amplitude of the cycle will be taken out by the moving average. Therefore, nearly all of it will reappear in the deviations of the respective figures from the moving average when plotted as in Figure 2. The deviations from the moving average are plus or minus, but by adding 2.000 as a constant (logarithm 2.000 = 100%), negative figures are avoided. The 2.000 line thus becomes the axis in place of zero, and the deviations go up and down from it. Deviations being *from* the moving average, their plotting as in Figure 2

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*Leonard W. Wing. 1953. Cycles of Lynx Abundance. *Journal of Cycle Research,* 2:26-49.

**Lacroix, Adrien, and Charles L. Ragot. 1938. A Graphic Table Combining Logarithms and Anti-logarithms. The Macmillian Co., New York.

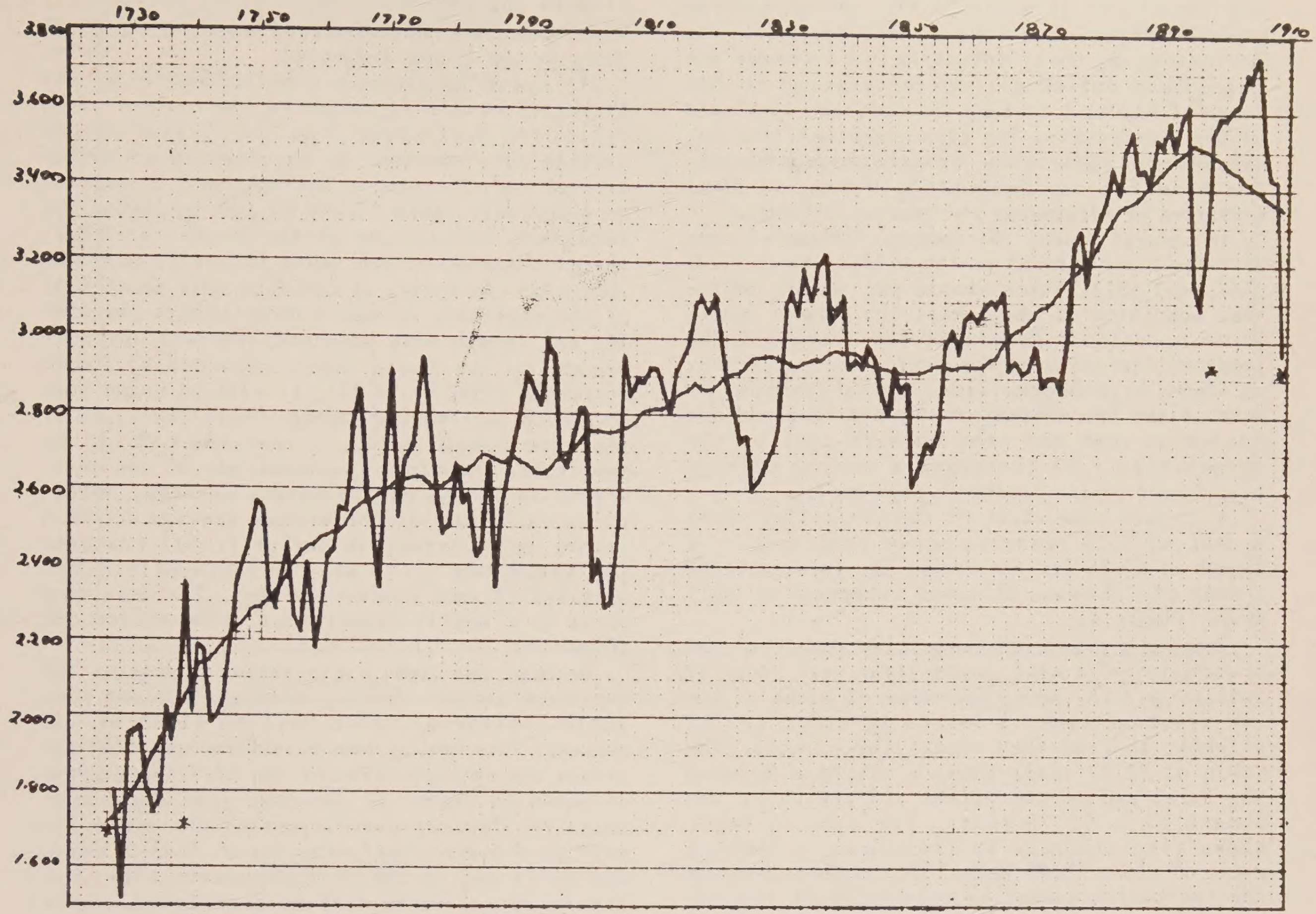

Figure 1. European Partridge (*Predix, predix*) hunting record (1727-1909) on an estate at Krumau and 23-year moving average. The asterisks (*) mark the extension of the moving by graphical extrapolation.

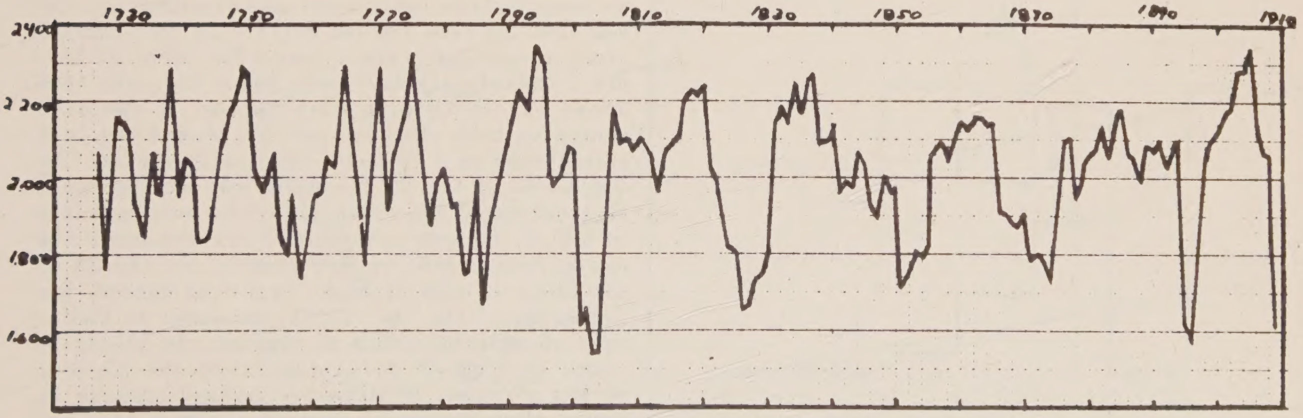

Figure 2. Deviations of logarithms from the 23-year moving average as extended by extrapolation.

has the effect of plotting the moving average as a straight line (the axis from which the deviations do their deviating)—as though one pushed and pulled the moving average in the curve of Figure 1 to form the straight line axis of the lower curve. The trend, whether from increased gun efficiency or otherwise, becomes the base for our reckoning. Hence, we have minimized or eliminated its drastic influence.

In several cases, the apparent length of some 23-years shows a break in the middle, as at 1733, 1768, and 1813, which should put one on notice that something of about half the longer length is in operation. By continuing free hand the apparent direction of the moving average trend, as shown by a broken line, it is possible to extrapolate the deviations. Values obtained are eleven at each end (the numbers lost by the impossibility of centering a moving average beyond half of its length at each end).

A 22-year time chart of the deviations shows a drop of 5.75 years in seven intervals or a length of 22.75 for the cycle. The lows indicate a drop of 5.0 years in seven intervals or 22.7 years (Figure 3).

Because a graduated scale also supported the probability of a near twenty-three year cycle by indicating a rhythmic occurrence of areas of low and areas of high, I set up periodic tables slightly shorter than twenty-three years. The table of 22.67 years shows a slippage between the first and second halves and indicates the length to be 22.75 years. Yet a 22.75 table shows also slippage and indicates a shorter cycle of about 22.67 years. The conflict between the two tables cannot be resolved with the few repetitions of the cycle, there being but eight in the 183 years between 1727 and 1909, inclusive. Hence, we can say that the probable length lies in the region of 22.67 to 22.75 years. I have taken the mathematical average of 22.71 years as the length indicated.

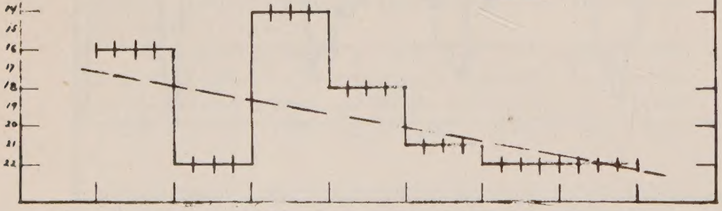

FIGURE 3. A 22-YEAR TIME CHART OF THE DEVIATIONS IN FIGURE 2 SHOWS THE BANDS OF HIGHS (UPPER) AND LOWS (LOWER) SLOPING DOWNWARD TO THE RIGHT. THE SLOPING LINE DROPS FIVE YEARS IN THE SEVEN INTERVALS TO INDICATE A CYCLE LENGTH 5/7 YEARS LONGER THAN 22 YEARS.

In order to minimize the influence of any cycles of about half length of the evident alpha cycle, the deviations from the 23-year moving average were smoothed by an eleven-year moving average and this moving average used in setting up a periodic table (Table 2) for measuring the amplitude and timing of the cycle (as 22.71 years). Because eleven years is nearly half the length of the cycle, it contains only about half of the amplitude of that cycle (though the timing and length have been undisturbed). By reference to the Foote Chart (*Journal of Cycle Research*, 1953, 2: 34-35), it will be noted that an eleven year moving average, which is 49.3% of the wave length of 22.71, retains 65% of the amplitude. Therefore the amplitude of the deviations is 100/65 of the moving average. Multipling each item of the moving average by this figure as a correction factor (1.54) restores the amplitude (*i.e.* as a deviation from the original 23-year moving average). The resulting curve is a nearly symmetrical, sine-shaped one (Figure 4).

Because the alpha cycle rather dominates the Partridge series, further analysis for any possible additional cycle will be aided by its removal. This may be done by subtracting from the series the average value of the 22.71-year cycle as shown in Figure 4. The near sine shape suggests the logical postulate that the cycle itself is a symmetrical sine curve. Such a curve may be fitted to the data mathematically. But little actual error will be introduced by the more convenient graphical fitting as in Figure 5. Because the cycle length does not fit the calendar year, some adjustment will be necessary in subtracting it from an even-year series. (The nearest even calendar length would be 100 cycles of 22.71 years) but the cycle may be subtracted as twenty-three years with an adjustment at the year 1867 to care for the extra 0.29 year carried along as part of a whole year. The curve of Figure 3 extends slightly more below the axis than above it. In keeping with custom, a new axis centering both the high and low phases has been established at 0.10 below the previous axis. The amplitude of the 22.71-year cycle at the crest is logarithm 2.165 which gives the antilogarithm of 146.2. Because this amplitude measures the cycle from trend, we may read it as 146.2% of its trend at time of high. In a like manner, the logarithm of the low (1.835) measures as amplitude of 68.4% of trend at the low. It should be noted this is as deviations from the 23-year moving average. Because the moving average is longer than the cycle, it took out more than the amplitude of the cycle which would be equivalent to increasing the amplitude of the deviation. Because of the slight difference between 22.71 years of the cycle and 23 years of the moving

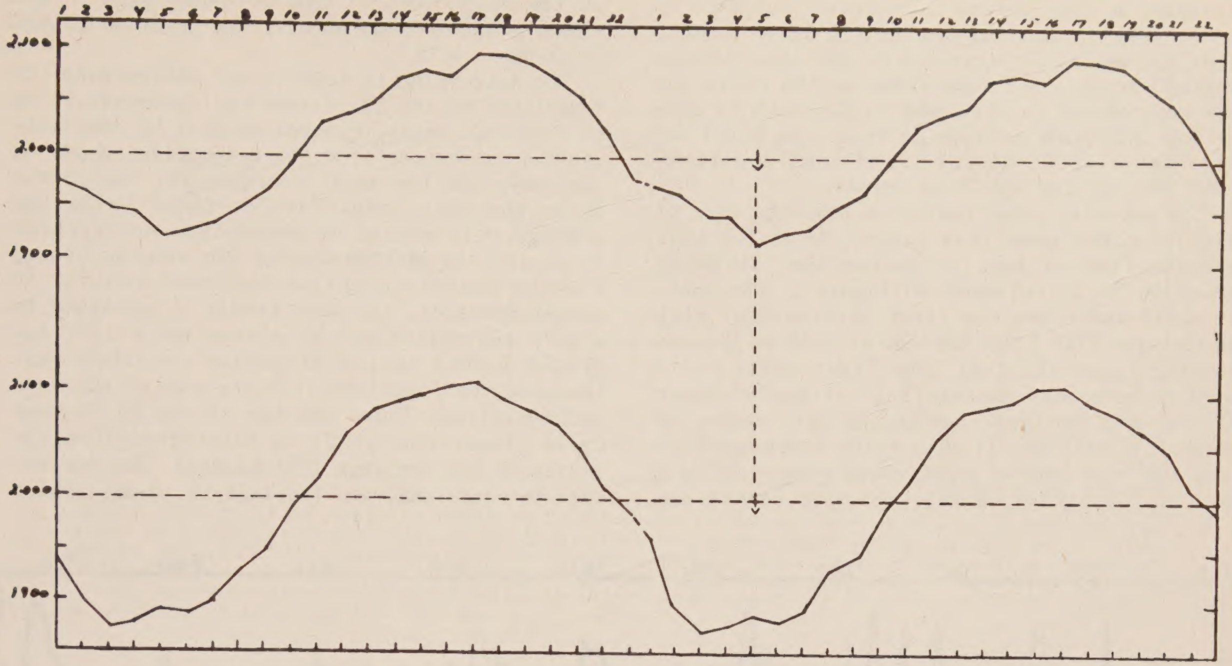

FIGURE 4. GRAPHS OF THE TWO HALVES OF THE 22.71-YEAR PERIODIC TABLE OF DEVIATIONS OF THE 11-YEAR MOVING AVERAGE FROM THE 23-YEAR MOVING AVERAGE SHOW NO APPARENT SLIPPAGE.

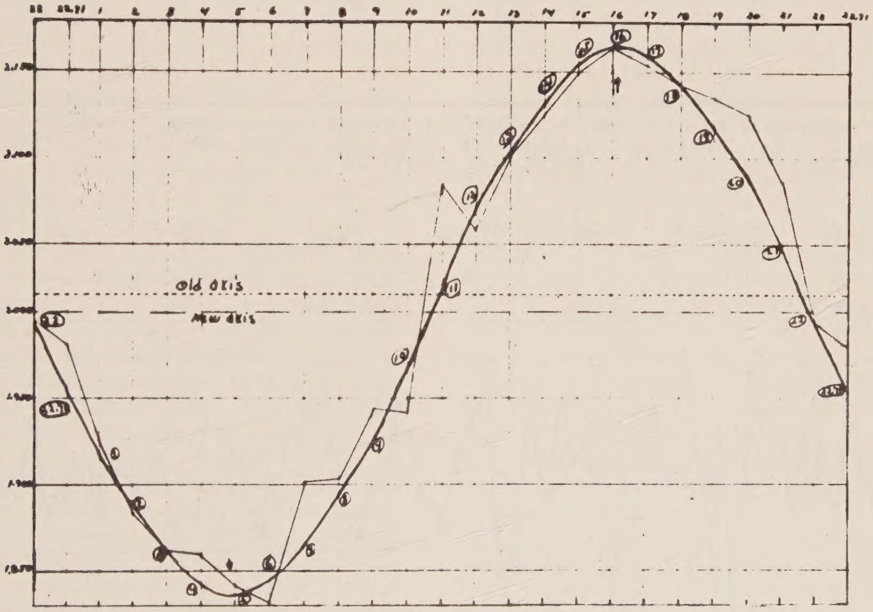

FIGURE 5. GRAPHICAL FITTING OF A SMOOTHED SINE CURVE TO THE DATA OF THE 22.71-YEAR CYCLE. THE SMOOTHED VALUES MAY BE READ OFF THE GRID AT THE NUMBERED POINTS.

average, a very slight correction needs to be made. This is done by use of the Foote Chart, just as mentioned previously for the 11-year moving average. The logarithms of the crest and low are *reduced* in this case by about 1% to give a final amplitude measure of logarithm 2.163 for the high (145.5% of the trend) and logarithm 1.837 for the low (68.7% of trend).

The periodic table indicates that the time of high or crest came just before the fifth year and the time of low just after the sixteenth year. On the fitted curve of Figure 5, the point of crest indicates the first mathematical peak at the year 1747.2 and the low at 1735.9. Because hunting is in the fall, the first crest would seem to have been in late fall or early winter of 1747 and the first low in the late summer or early fall of 1736. If this cycle continued this way, the most recent crest would appear to have been in the spring of 1952 and most recent low at the beginning of the calendar year 1941. Figure 6 shows by an overlay the position of the 22.71-year cycle.

The data being in logarithms, subtracting the logarithms of the 22.71-year cycle removes it on a *percentage* basis. Removal is done by subtracting the difference from the respective points on the curve and the axis, positive for the points above the axis, negative for those below the average. (It should be noted that subtraction of a curve is mathematically the same as though a curve exactly opposite had been added). In actual practice, the same result is obtained in a more convenient way by adding the axis (logarithm 2.000) to the deviation and then subtracting the logarithm from the sum of the axis and deviation. Thus, the low of the 22.71-year cycle (logarithm 1.835) is subtracted from the deviation for the year 1781 (1.915). The difference between 1.835 and the axis is -0.165, which

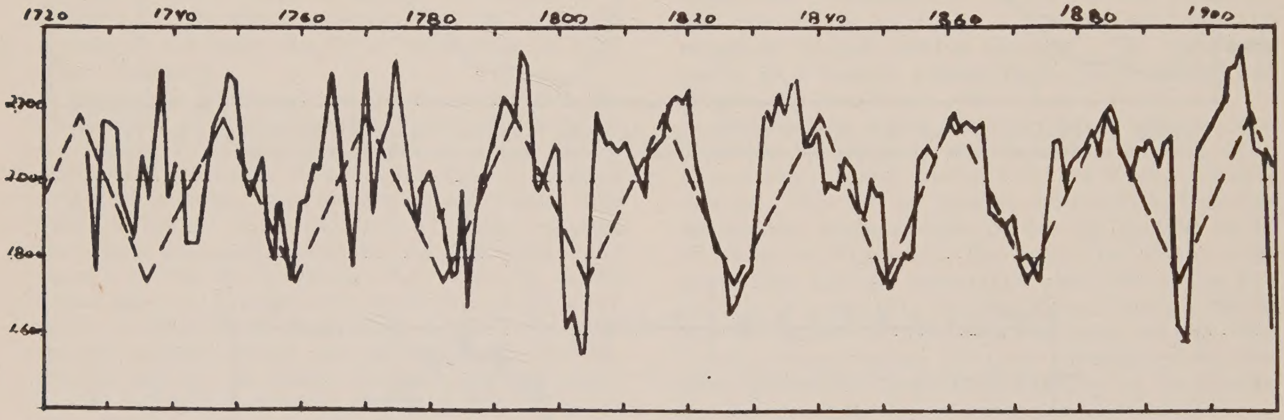

FIGURE 6. THE DEVIATIONS OF LOGARITHMS FROM THE 23-YEAR MOVING AVERAGE AS IN FIGURE 2 WITH A REGULAR 22.71-YEAR ZIG-ZAG CURVE LAID OVER IT TO SHOW TIMING AND AMPLITUDE. THE PROBABLE SHAPE OF THE 22.71-YEAR CYCLE MAY BE SEEN IN FIGURE 24.

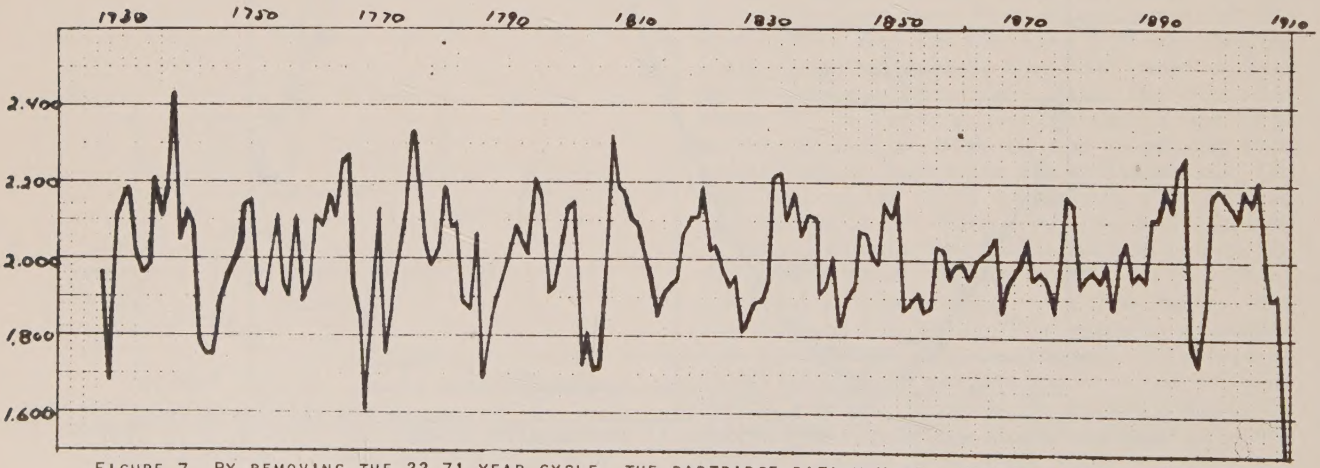

FIGURE 7. BY REMOVING THE 22.71-YEAR CYCLE, THE PARTRIDGE DATA MAY BE EXAMINED FURTHER. THE PRESENCE OF SEVERAL RHYTHMS SEEMS EVIDENT IN THE CURVE RESULTING FROM SUCH REMOVAL.

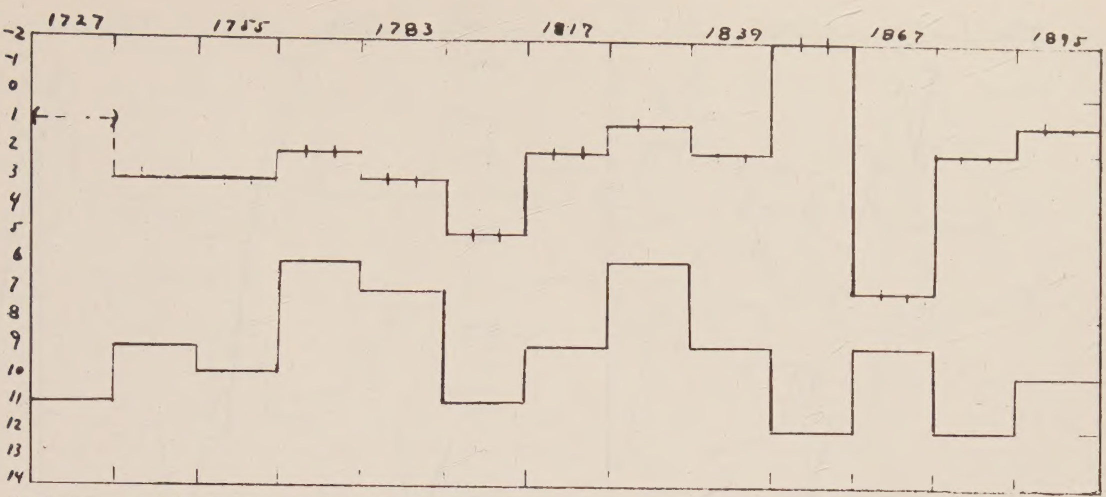

FIGURE 8. A 14-YEAR TIME CHART OF THE DEVIATIONS AFTER REMOVAL OF THE 22.72-YEAR CYCLE INDICATES A CYCLE OF ABOUT FOURTEEN YEARS AS SHOWN BY THE HORIZONTAL RUN OF THE RESPECTIVE BANDS OF HIGHS AND LOWS. IT ALSO INDICATES A POSSIBLE REVERSING CYCLE COMPOSED OF THE LEFT END OF THE LOWS (TOP) RIGHT HALF OF THE HIGHS (BOTTOM) WHICH WILL MERGE AT ABOUT THE 1797 INTERVAL. IF REAL, IT WOULD INDICATE A PROBABLE COMPOSITION OF ABOUT 13.95 AND 16.25-YEAR CYCLE. A SIMILAR REVERSING CYCLE WITH APPARENT FALSE LENGTH OF 12.9 YEARS MAY BE COMPOSED OF ABOUT 11.8 AND 14.2-YEAR CYCLES.

subtracted from 1.915 gives 2.080 as the logarithm of the residual. But if the axis of 2.000 is added to 1.915 first, 1.835 subtracted from the sum of 3.915 will give the same 2.080, yet avoid the use of negatives.

The new curve obtained by removing the 22.71-year cycle (through subtraction of logarithms) is plotted in Figure 7. A cursory inspection indicates a number of areas of weakness and strength, which suggests that the 22.71-year cycle is not the only one in the series. Several lows and highs fall into a pattern of about thirteen to fifteen years. Graduate scales of these lengths indicate a better fit at fourteen years than at either thirteen or fifteen. A fourteen-year time chart has been made (Figure 8), which establishes the probability of a cycle of about fourteen years with sufficient clearness to justify search with a periodic table. It shows also that the curve indicates rather strongly a possible cycle of about two years shorter length. The fourteen-year periodic table (Table 3) has been sectioned by eight overlapping cycles 1726-1824, 1796-1894) to eliminate the influence of a possible 12-year cycle, which would slip two years in each cycle interval or fourteen years in seven intervals between eight cycles. Hence, it would appear equally in each of fourteen columns when sectioned thusly. The average median for the second section shows a slippage of about a fourth of a year from the average median of the first. Since this slippage is to the left with respect to the first section (Figure 9), it indicates a length shorter than fourteen years. There are five cycles between the centers of each section, which gives an average slippage of about a twentieth of a year for each cycle, or 13.95 years as a mathematical length.

The amplitude of the cycle may be obtained by taking the average medians of the respective columns of the entire periodic table. This has been plotted in Figure 10. The curve has a zig-zag shape instead of the sine-shape of the 22.71-year curve. It is obvious that we have no way of knowing as yet whether the curves of such cycles fundamentally are sine-shaped, zig-zag, or otherwise. Hence, it seems realistic to use them as of the type evident in the data. A curve has been fitted to eliminate slight irregularities in shape. I have used this fitted curve to remove the cycle from the data in the same way as the 22.71-year cycle was removed. Because 13.95 varies from 14-years by only a twentieth of a year, I have taken the cycle on a fourteen year basis but adjusted by a year at 1879 to allow for the twentieth of a year. Obviously, it would take 279 years for a perfect fit of 13.95 and the calendar itself, but a 14.00 year length would be off only one-year in that length even without any adjustment.

The amplitude of the average cycle in the periodic table (Table 3) varies from about logarithm 2.152 at the crest in position-10 to logarithm 1.865 at the trough in position-3. The shape is symmetrical (intervals between positions 10 and 3 or between 3 and 10 are substantially the same), though the crest is higher above the axis of 2.000 than the trough is lower. By

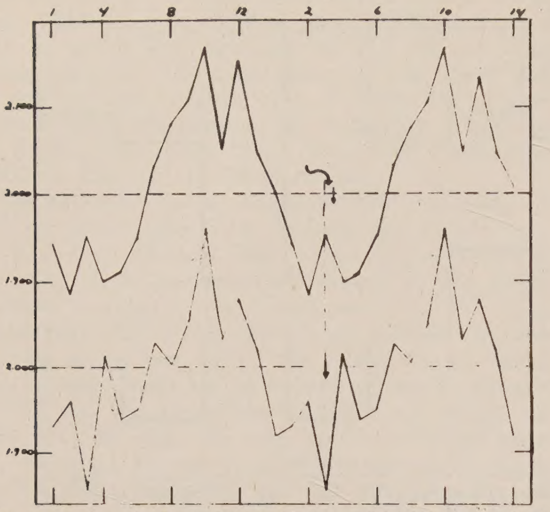

FIGURE 9. A FOURTEEN YEAR PERIODIC TABLE (TABLE 3) SHOWS A SLIPPAGE TO THE LEFT OF THE SECOND PART WITH REFERENCE TO THE FIRST, WHICH INDICATES A CYCLE LENGTH ABOUT A TWENTIETH OF A YEAR SHORTER THAN THE TABLE OR 13.95 YEARS.

centering the cycle on its axis, a series of adjusted values may be read off the fitted curve for removal from the series.

The timing of the apparent cycle may be determined from the periodic table. Because the first column represents the years 1727, 1741 etc., position-3 will represent 1729, 1743, etc., while position-10 represents 1736, 1750, etc. By successive applications of the mathematical length of 13.95, the most recent low of such a cycle if continued would have been 1952.2, which would seem to mean the end of the 1952 calendar year. In a similiar way, the most recent high would have been 1945.25, evidently in the winter 1945-46.

The amplitudes at crest (logarithm 2.140) and trough (logarithm 1.835) indicate that the cycle should be designated as the *beta cycle*. For final interpretation of the amplitude, it is necessary to adjust for the loss to the 23-year moving average. The latter is 164.87% of the cycle length and the Foote Chart indicates that for a zig-zag curve, 14% of the original amplitude remained in the moving average. In actual effect, this means that the deviations from the moving average have been increased so far as the 13.95-year is concerned. To find the correct amplitude in the original series, we must restore to the deviations the amount retained by the moving average. In case of a negative retention, deviation must be appropriately reduced. Because 14% is in the moving average, the amount in the deviation would be 114%. A restoration factor is readily computed by dividing 100 by 114 which gives 87.7% as the restoration factor for the deviations. The deviations of logarithms 2.140 and 1.860 at crests and lows respectively would be corrected by applying 87.7% to the difference between the deviation and axis (0.140) to give new values of 0.123 above and below the axis, or 2.123 for the crests and 1.877 for the highs. By converting the amplitude in logarithms to whole numbers (which will then be percent of trend), the amplitude is indicated as 132.7%of the trend at the time of high and 75.3% at the time of low.

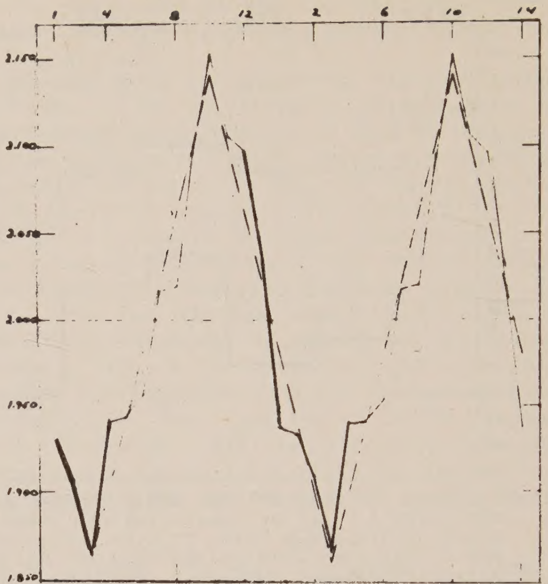

FIGURE 10. THE 13.95-YEAR CYCLE HAS A ZIG-ZAG SHAPE. IT MAY BE IDEALIZED AS SHOWN BY DASHED LINES AND NEW VALUES FOR THE IDEALIZED CURVE MAY BE READ OFF THE GRAPH.

The residual after subtraction of the 13.95-year cycle from the previous residual left after the subtraction of the 22.71-year cycle is used for further analysis because the 13.95-year cycle overrode other cycles.

Because an earlier inspection had indicated possible rhythmic strength at about twelve years length, a further test at this length seemed to be the next logical step. Hence, a 12-year graduated scale was run across the residual of the data. It indicated enough repeated areas of strength and weakness in the twelve-year range to show a probable cycle. A time chart was prepared accordingly for a twelve-year length (Figure 11). A tendency for the bands of highs and lows to rise to the right suggests a length slightly shorter than the twelve-year intervals. An extra low at 1775 interval and an extra high at the 1799 interval may be accidental or the result of other cycles. The residual itself also suggests possible cycles in the range of a third to two-thirds the 12-year length. It should therefore be examined for a possible cycle web in the four to eight years range. The rise of the lows in the 12-year time chart seems about 2 1/4 years for the fourteen intervals between 1727 and 1883; it averages 0.18 years for each

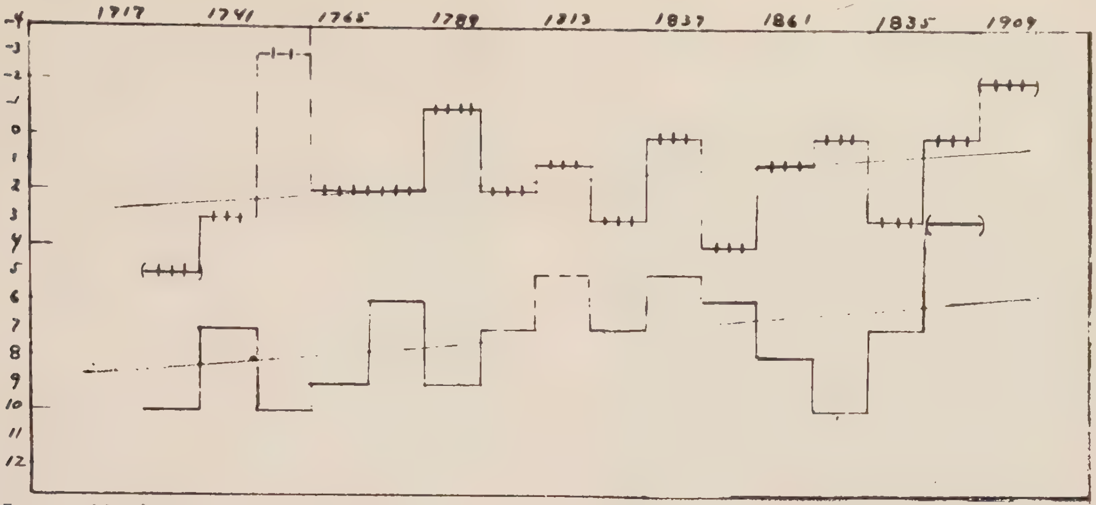

FIGURE 11. A 12-YEAR TIME CHART SHOWS A SLOPE DOWNWARD TO THE LEFT IN THE HIGHS (BOTTOM) LOWS (TOP), WHICH INDICATES A CYCLE LENGTH A SIXTH OF A YEAR LESS THAN THE INTERVALS OF THE TIME CHART. PERIODIC TABLES ESTABLISH THE LENGTH AT 11.84 YEARS.

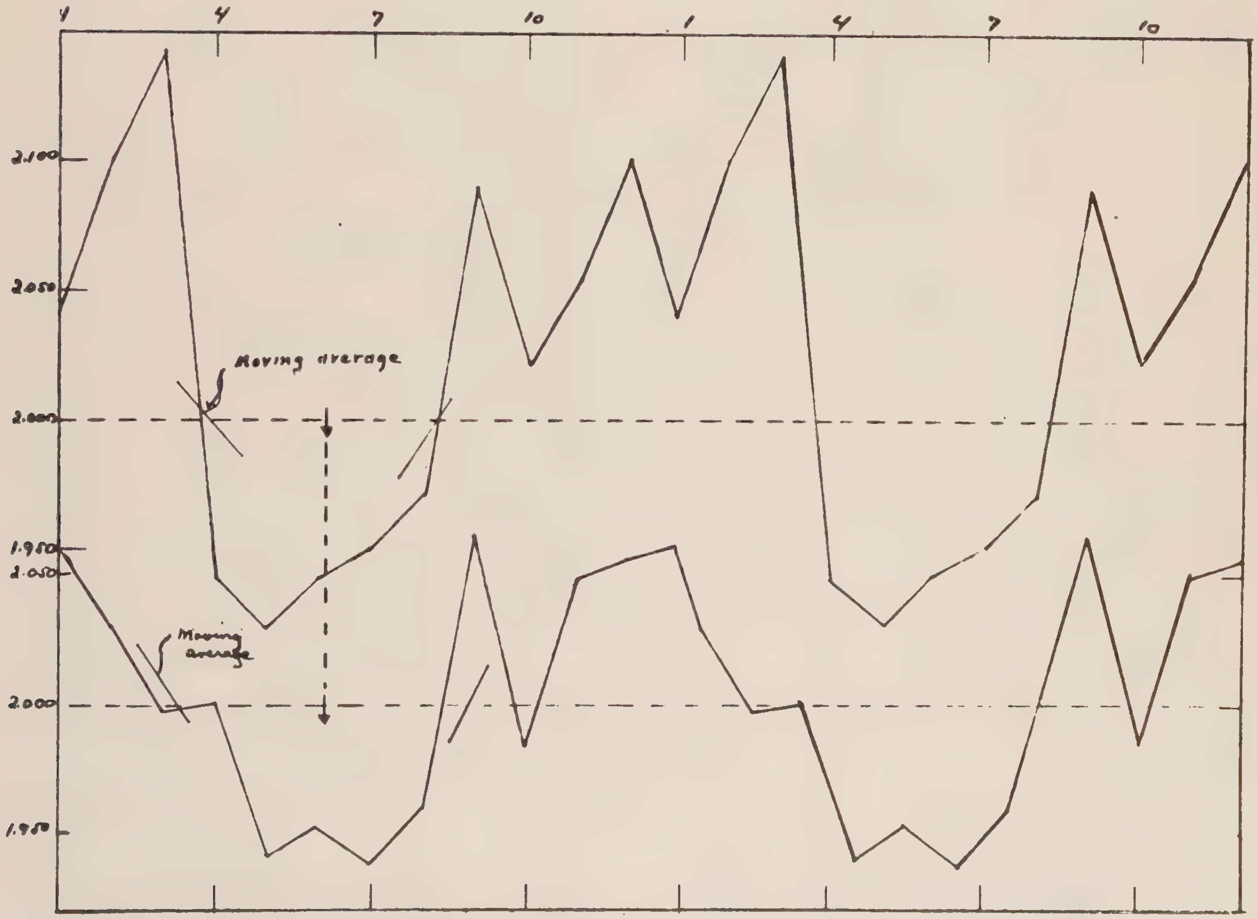

FIGURE 12. A GRAPH OF THE TWO HALVES OF THE 11.84-YEAR PERIODIC TABLE (TABLE 4) SHOWS NO MEASURABLE SLIPPAGE BETWEEN THE TWO PARTS OF THE TABLE.

cycle to suggest the cycle length as 11.82. In a similiar way, the highs rise about two years in the fourteen intervals between 1739 and 1895 for an average of a seventh or 0.14 years for each cycle to suggest a length of 11.86.

Because the average of the two is 11.84 years, I used this as the length to be tested further by a periodic table of 11.84 years (Table 4). The average medians for two eight-section parts of the table (1726-1809, 1809-1890) show a very slight slippage that may indicate an actual length shorter than the table, but the slippage is too slight for practical measurement (Figure 12). Hence, it should be considered as a cycle the length of the table itself.

Because the curve of Figure 12 has several short fluctuations, either from other cycles or random events, a three-year moving average will minimize or eliminate most of them. The 3-year moving average will also reduce the amplitude of the 11.84-year cycle, but this can be returned to its original amplitude by a simple operation. The moving average of three-years is 25.3% of the length of the 11.84-year cycle. The Foote Chart indicates that a moving average of this relative length retains 74.7% of a zig-zag curve. (Because Figure 13 gives the impression of a zig-zag curve, I have considered the curve as possibly a zig-zag one, though of this we can not be certain.) The difference in retention by a moving average though greater for a sine curve is not enough to be of practical importance. (Possibly one should use an average for the two types of curves in cases of doubt). For the reason that we are reconstructing the amplitude of the curve from the moving average, each item should be multiplied by 100/74.7 or 1.34. These values are then plotted and a curve fitted graphically to smooth out minor irregularities (Figure 13). The values range from 1.966 at the low of position-6 to 2.100 at the high of position-1. The fitted curve indicates that the actual low probably falls a little beyond position-3 and the actual crest about 3/8 the distance between position-11.84 and position-1. The mathematical point of lows and highs is indicated respectively in Figure 13 as about position-3.3 and position-12.38. This brings the first low at 1732.2, the first high at 1738.38. If these mathematical renditions are correct the first low would have been in the winter of 1732-33 and the first high in the winter of 1738-39. If the cycle continued this pattern, the most recent low would have been in the early spring of 1946 (mathematically 1745.42); the most recent high would have been in the spring of 1952 (mathematically 1951.5).

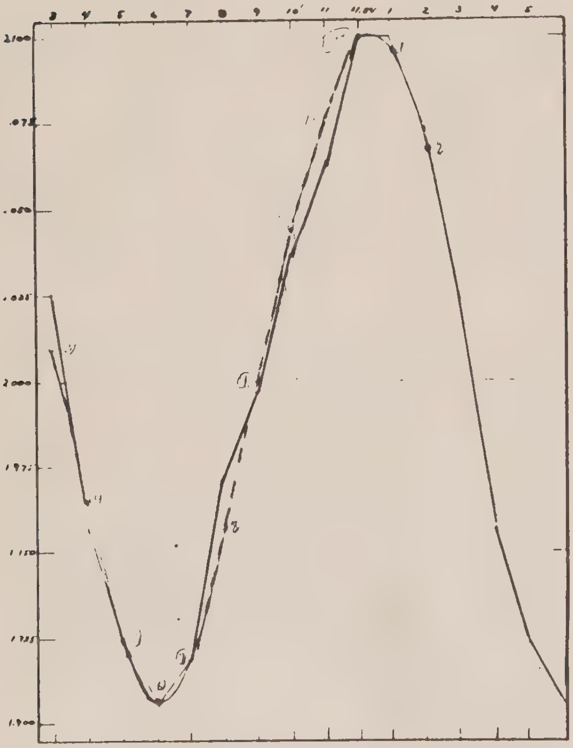

FIGURE 13. THE AVERAGE MEDIAN OF TABLE 4 HAS BEEN SMOOTHED BY A THREE-YEAR MOVING AVERAGE AND RESTORED FOR RETENTION OF AMPLITUDE BY THE MOVING AVERAGE. THE SHAPE APPEARS TO BE A SINE-SHAPE AND AN IDEALIZED CURVE MAY BE FITTED AS SHOWN AND NEW VALUES READ OFF THE GRAPH.

The amplitude of the 11.84-year cycle as measured by Table 4 and Figure 14 is logarithm 1.903 at the low and logarithm 2.097 at the high. Because the 23-year moving average has influenced the 11.84-year cycle, a correction must be made to restore loss to the 23-year moving average. The 23-year moving average is 194.26% of the length of the cycle, which length lies between half and a third of that of the moving average. Moving averages *reverse* the amplitude of such a cycle, which amounts to -2% as shown by the Foote Chart. The amplitude of the deviations from the 23-year moving average are in the ratio of about 102:100 to the original amplitude or 99%. Hence, the amplitude of the deviations must be reduced by about 1%. This gives a restored amplitude of logarithm 1.904 at the low and logarithm 2.096 at the high. These may be readily converted to whole numbers by means of a logarithm table, which whole numbers become a measure in percentage and may be read as 124.7% of trend at the high and 80.2 percent of trend at the low. It is possible that this cycle is the third most dominant cycle (gamma cycle) in the series.

The time chart of Figure 12 suggests the possibility that the band of highs also runs into the band of lows at about 1857 to indicate a reversing cycle of about 11.25 years. The low at 1754 may be the other reversal point to indicate a synodic period of 9.5 cycles. If this is true, the 11.84-year cycle is one component of an 11.25 reversing cycle, its complement being a cycle of 10.66 years.

Several cycles in the four to eight year range are evident in the residual of the data and it seems worth while to measure several of them. A pattern of about eight years appears in several groups of lows. It seems clear enough to justify a periodic table of eight years length (Table 5). The table has twenty-three repetitions of eight years (less one item in position-8 of the 1902 interval) and has accordingly been divided into two sections of twelve cycles each (1726-1814, 1814 to 1902) with eleven cycles between their respective centers. The average medians of the two sections have been plotted in Figure 14. While they indicate a probable cycle in the eight-year neighborhood, it is masked by a tendency for two highs and lows where one should be expected. I accordingly took a four-year moving average, which would eliminate any four year cycle, even though it would reduce the amplitude of an eight by one-half. This moving average shows a slippage of slightly less than a half year between the two parts of the table. This slippage in eleven cycles (from Base 1766 of the first half to Base 1854 of the second) between the median positions of the parts of the table indicates a cycle about a twentieth of a year longer than eight years, mathematically 8.05 years.

The four-year moving average eliminates all of the amplitude of any four-year cycle and nearly half of that belonging to the 8.05-year cycle. The respective figures for the moving average were restored to the previous amplitude by doubling the difference between the figure and the axis to get a curve for the average median of the 8.05-year cycle as shown in Figure 15. As the curve is markedly off-center from its axis, I centered it about a new axis as shown and fitted a zig-zag curve. This indicates an amplitude of logarithm 1.962 at position-1.5 and logarithm 2.038 at position-5.5. If the indicated points of low and high are correct, the first low evidently was in the spring of 1728 (1727.5) and the first high in the spring of 1732. If the cycle has continued in this manner, the most recent low should occur in the summer of 1953 (1952.9) and a high should have occurred in the summer of 1949 (1948.85).

Because the 23-year moving average is 285.71% of the length of the 8.05-year cycle it would have retained about 4% of the cycle amplitude. The amplitude of the deviations is thus 96% in terms of the original series and may be restored by a correction factor of 1.04 (100 divided by 96). The deviations of 1.962 and 2.038 are 0.038 from the axis and a correction of 1.04 will make them 0.040 from the axis or 2.040 and 1.960, respectively. They can be converted to percentage

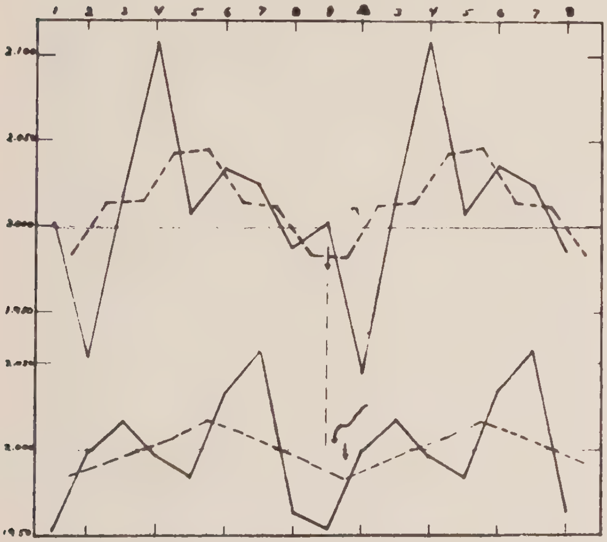

FIGURE 14. THE TWO PARTS OF THE 8.05-YEAR PERIODIC TABLE SHOW NO MEASURABLE SLIPPAGE WHICH ESTABLISHES THE LENGTH OF THE CYCLE AS 8.05 YEARS.

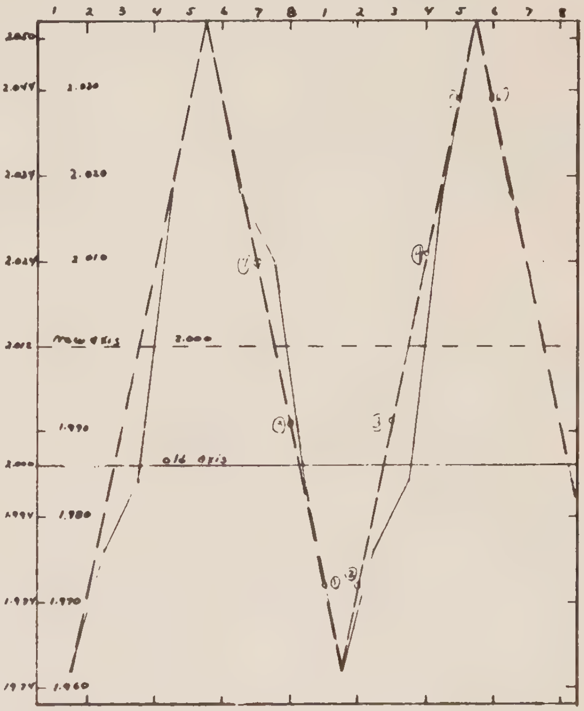

FIGURE 15. THE AVERAGE MEDIAN OF THE 8.05-YEAR CYCLE HAS BEEN RESTORED FOR LOSS TO THE MOVING AVERAGE AND FITTED TO A REGULAR ZIG-ZAG CURVE (DASHED LINE). NEW VALUES MAY BE READ OFF THE CURVE AS SHOWN.

of trend by use of a logarithm table, and the resulting amplitude may then be read as 109.6% of trend (logarithm 2.040) at high and 93.3% of trend (logarithm 1.960) at the low.

I have already mentioned a suggestion of two crests and troughs in the average medians of the 8-year periodic table, particularly in the second section (Figure 14). To test for a possible four year cycle while avoiding the laborious process of setting up a four year periodic table, I made a horizontal section of Table 5. This was done by dividing the eight year median for the first section (1726-1814) into two halves and combining the two halves into a four-year median (columns 1-4 added respectively to columns 5-8). The second section (1814-1902) was treated likewise to obtain the average as in Table 6 and Figure 16. The second section (1814-1902) shows a slippage (to left or right) of either 91/32 years or 38/32 years for the twenty-three intervals between the respective centers of the sections. Hence, it indicates a cycle of either 3.95 years or 4.12 years length.

Because of this strong indication of a true cycle in the four-year range, I set up a 4-year periodic table and divided it into two sections of twenty-four intervals each. The slippage of the two sections followed that of the two halves of the 8-year table to show a cycle of either 3.95 or 4.14 years (Table 7, Figure 17). If the slippage is true, the point remaining to be settled is whether it is to the left (indicating 4.13) or to the right (indicating 3.95). The highs and lows should move across the 4-year table from column to column, taking about eight intervals for the 0.13 slippage (about one-eight year for each interval) and about twenty intervals for the 0.05-year one (about one-twentieth year for each interval). The color of the high (black) and lows (red) values in the table should line up accordingly. I therefore ran a twenty-three interval moving column average down the respective columns (intervals 1-23 inclusive of column one centered at interval 12, 2-24 inclusive of column one centered at interval 13, etc.). The resulting column averages indicate rather plainly that the slippage is to the *right*, which indicates in turn that the cycle is longer than the four years of the table (Table 8).

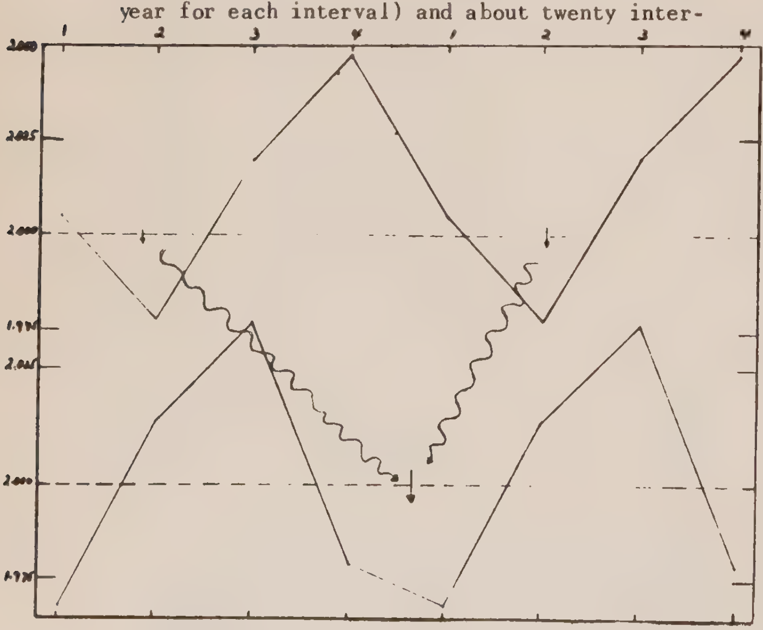

FIGURE 16. FOUR-YEAR HALVES (1726-1814) AND (1814-1912) OF AN 8-YEAR PERIODIC TABLE SHOW A SLIPPAGE TO THE RIGHT OR TO THE LEFT.

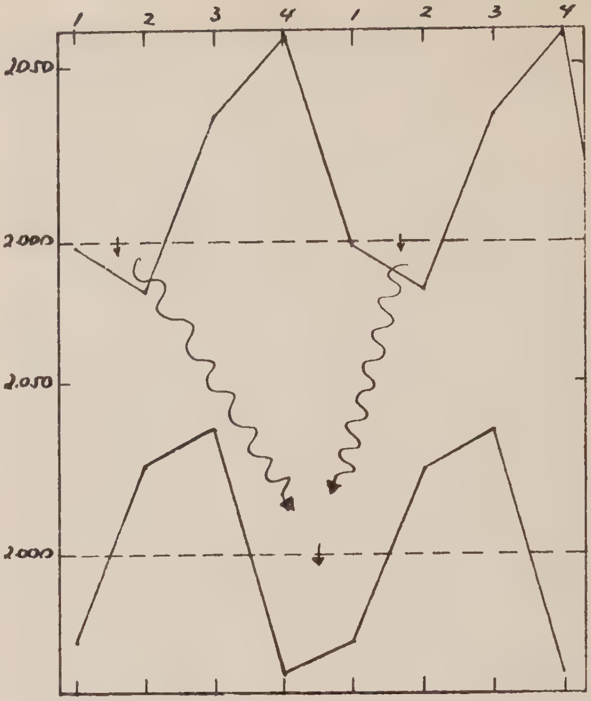

FIGURE 17. THE TWO HALVES OF 4-YEAR PERIODIC TABLE SHOWS SUBSTANTIALLY THE SAME CYCLE AND SLIPPAGE AS IN FIGURE 16.

In order to determine more precisely the apparent length of the cycle indicated as 4.13 years. I set up a 4.13-year periodic table (Table 9). This also measures more clearly the amplitude of the cycle, for a table of the exact length of a cycle gives maximum amplitude. The second half of the 4.13-year table shows a slippage to the right of 3/26 years in twenty-two cycles with respect to the first half (Figure 18), which means that the cycle is longer than the table by about .01 years to make a length of 4.14 years as the best representation.

The average value of the amplitude, as taken from the respective columns of Table 9, appears in Figure 19. The curve has a zig-zag appearance varying from a high of 2.044 to a low of 1.981. Because a zig-zag curve seems the best fit, I fitted one graphically and centered it on a new axis so that the distance above and below would be the same. From the new axis, values may be read off for the fitted value of the curve. These

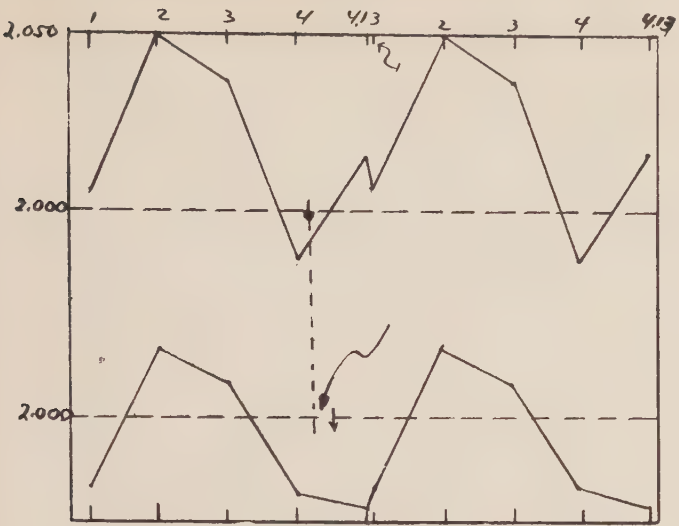

FIGURE 18. A 4.13-YEAR PERIODIC TABLE SHOWS A SLIPPAGE OF THE SECOND HALF FROM THE FIRST HALF OF 3/26 YEARS IN TWENTY-TWO CYCLES. THIS INDICATES A LENGTH OF 1/22 OF 3/26 LONGER FOR EACH CYCLE OR 4.14 YEARS.

give logarithms of 2.032 for the high and 1.968 for the low, the latter appearing at position-4.07 (first low at year 1730.07, the fall of calendar year 1730). The first high appears at position-2 (year 1728, fall of calendar year 1728).

If this cycle continued as indicated, the most recent crest would have been at year 1951.56, (spring of 1952), and most recent low would be at year 1953.63 (spring of 1954).

The 23-year moving average is 555.56% of the length of the 4.14-year cycle, and about -3% of the amplitude remains in it. The deviations have 103% of the true amplitude. The original amplitude may be restored by *reducing* the value of the deviations by about 2% as the original value will be about 98% of the deviations (103:100). This gives a restored amplitude of logarithm 2.031 (107.4% of trend) at the highs and logarithm 1.969 (93.1% of trend) at the lows.

I have already mentioned that the data indicate a possible cycle web in the four to eight year range. The presence of a five-year cycle seemed likely when a ten-year graduated scale was applied initially to the deviations. Hence, it seemed worth while to return to this possibility and to test with a five-year scale. The five-year scale indicated a possible rhythm slightly longer than five-years, and a 5.1-year periodic table was prepared (Table 10). The two sections of the table (1726-1813, 1813-1899) show a very slight slippage, which indicates a length about 0.01 years less than the table or a cycle of about 5.09 years. The average median of the table (Figure 21), shows a value of 2.050 at the high and 1.969 at the low. It also shows that the curve probably has a zig-zag shape. A curve was thus fitted and centered around an axis to give fitted values of 2.041 at the high and 1.959 at the low. The high appears near the third position and the low in the 5.09 position to give a probable year of first crest at 1728.8 (summer of calendar year 1729) and of first low at 1726 (fall of calendar year 1726). If this representation continues to the present, the most recent crest would be in the summer of 1953 (1952.76) and its low in the fall of 1955 (1955.05).

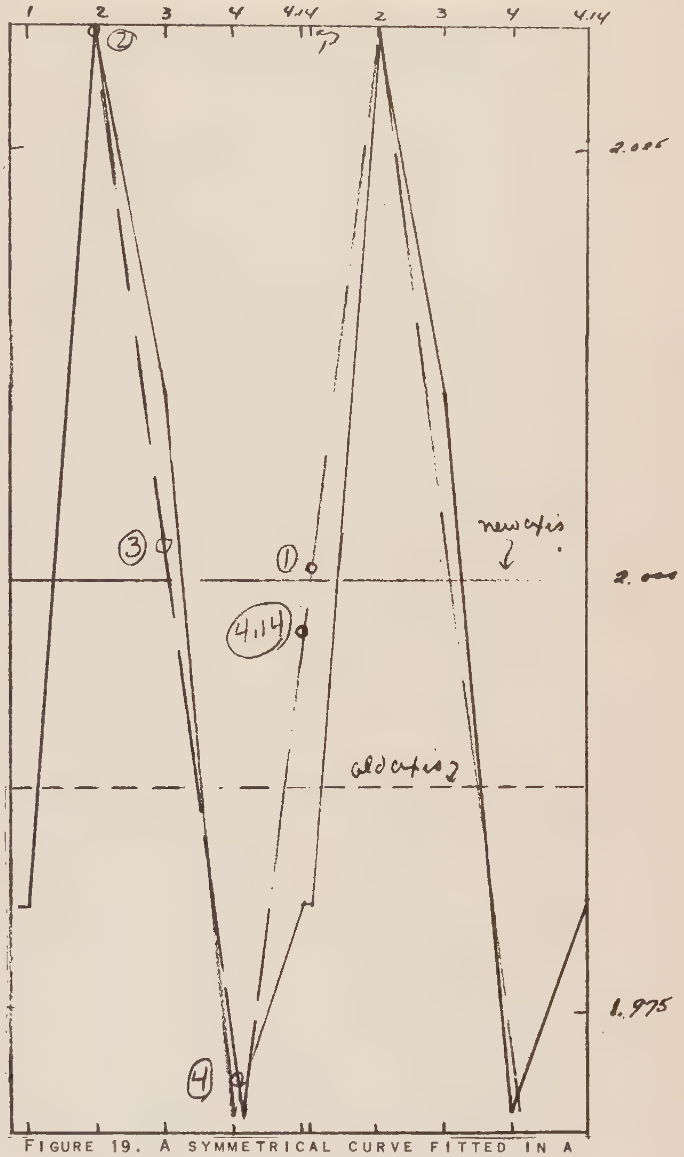

FIGURE 19. A SYMMETRICAL CURVE FITTED IN A ZIG-ZAG SHAPE AND VALUES READ OFF AS SHOWN HAVE BEEN USED IN ADJUSTING THE 4.14-YEAR CURVE. THE CURVE HAS BEEN CENTERED ABOUT A NEW AXIS AS INDICATED.

The 23-year moving average is 451.87% of the 5.09-year cycle and retains about 4 1/2% of its amplitude. The original amplitude may be restored by a correction factor of 1.047 (95.5:100) to give a logarithm at the high as 3.042 (100.2% of trend) and a logarithm at the low of 1.958 (90.8% of trend).

After removal of the 8.05 year average cycle, an apparent cycle of about 8-years length still seems to show in the residual. Yet a check shows that none of the 8.05-year cycle remains, which indicates clearly the presence of one or more additional cycles in the 8-year range. A graduated scale suggests three cycles in twenty-five years, and I set up a periodic table of eight and a third years (Table 11). The two sections (1726-1818, 1809-1901) show a very slight slippage if any, so that the cycle may be a little shorter than 8.33 years, but the amount can not be measured very well. Hence, it will do to call it 8.33 years (Figure 21). The average median of the whole table has an evident zig-zag shape (Figure 22). It also shows an asymmetrical shape (five year rise and three and a third year decline). It has an amplitude from logarithm 1.950 to logarithm 2.052, which can be centered on the axis as logarithms 1.949 and 2.051 respectively. A line with the high in position-7 and low in position-1 seems to render the best fit. The first high seems to have occurred in the fall of 1728. If this behavior continued, the most recent high would have occurred in the spring of 1950 (1949.7) and the most recent low will occur in the fall of 1953.

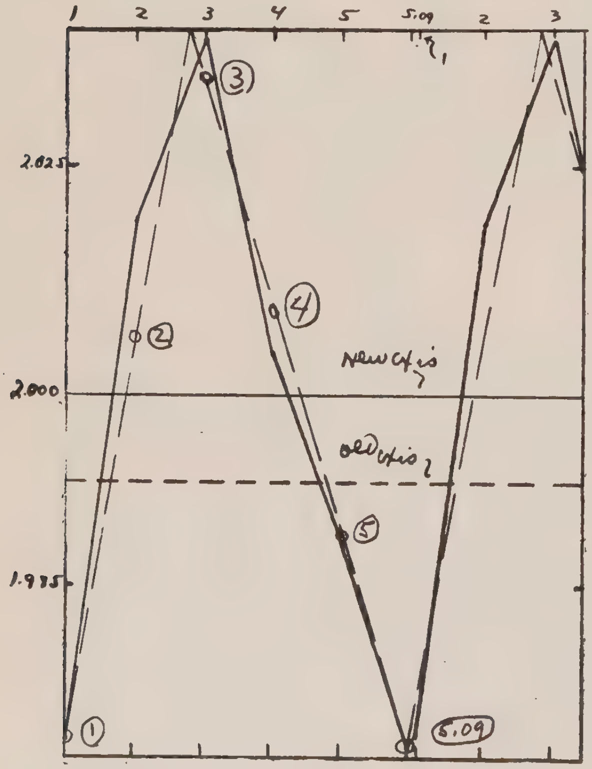

FIGURE 20. THE CURVE OF THE 5.09-YEAR CYCLE HAS BEEN FITTED IN A ZIG-ZAG SHAPE AND CENTERED ON A NEW AXIS. VALUES HAVE BEEN READ OFF THE GRAPH AS SHOWN.

Because the 8.33-year length is 276.0% of the 23-year moving average, the moving average retained about 6% of its amplitude. The necessary correction factor will be 106.4 (94:100), which increases the amplitude of the respective highs and lows from 2.051 and 1.949 to 2.054 and 1.946. By converting to whole numbers with a logarithm table, the amplitude may be read as 113.2% of trend at the high and 88,3% of trend at the lows.

Combining the Indentified Cycles

Knowing the probable positions of the highs and lows of each cycle as shown by the respective periodic tables, it is possible to compute the year when each would have occurred if they continued the average behavior indicated. Table 12 shows the years of highs thus computed and Table 13 the years of lows computed in a like manner.

The respective amplitudes of the seven cycles so far measured may be combined into a *manifest cycle* by adding the average amplitudes for the respective years. (Because these are logarithms, the manifest cycle is constructed on a percentage basis). The construction of such a manifest cycle, with appropriate adjustments between the calendar year and cycle length, appears in Table 14. Figure 23 graphs the seven cycles as deviations. Figure 24 shows a manifest cycle constructed from them and also a graph of the deviations. The manifest cycle has been removed from the deviations for a residual (Figure 25). The residual shows a behavior suggesting the presence of additional and unidentified cycles, there are also fluctuations that are probably of a random nature. While one could project the manifest cycle of deviations beyond the data and have a roughly indicative forecast, it probably would be necessary to analyze the residual

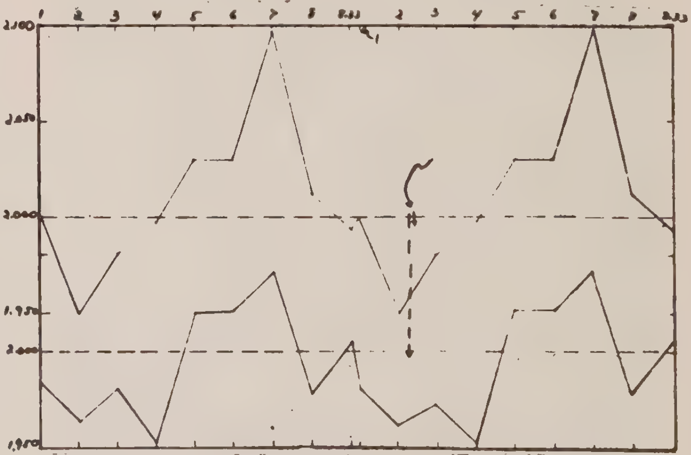

FIGURE 21. THE TWO HALVES OF THE 8 1/3-YEAR PERIODIC TABLE SHOW A SLIGHT SLIPPAGE SO THAT 8.33 HAS BEEN USED AS THE LENGTH INDICATED.

rather completely before the cycles could become the basis of a complete forecast.

Yet because the series ends in 1909, it presents a very real opportunity to test the validity of the seven cycles as a basis of forecast. Though all the cycles have not been isolated, the resemblance of the manifest cycle of the seven derivations (Figure 24) to the manifest cycle of the original (Figure 2) suggests the very real probability that it might follow the missing record from 1910 to date. Hence, if someone should find these data, we could test this possibility by extending the combining of the seven derivations in Table 14 from 1910 to date and comparing with the actual record. Though the missing record included the years of two world wars, it should "snap back" if the periodicities are real. The possible manifest cycle is shown in Figure 26 and combined in Table 15 for a future possible action.

Partridge at Norfolk, England

A record of the Partridge on a Norfolk estate (*Journal of Animal Ecology*, 3:231-249) from 1793 to 1933 suggests a possible comparative study with the Krumau record. But a graph of the figures (Figure 27) shows such a series of violent drops for single years with high values for pre-

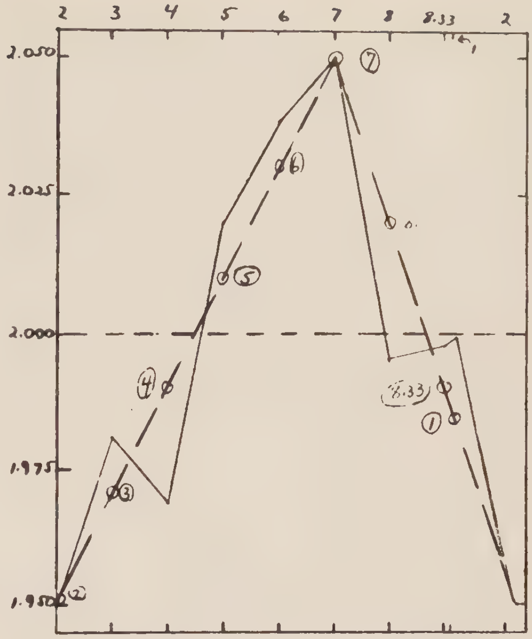

FIGURE 22. THE 8.33-YEAR CYCLE HAS BEEN FITTED AS SHOWN AND FITTED VALUES READ OFF THE GRAPH AS INDICATED.

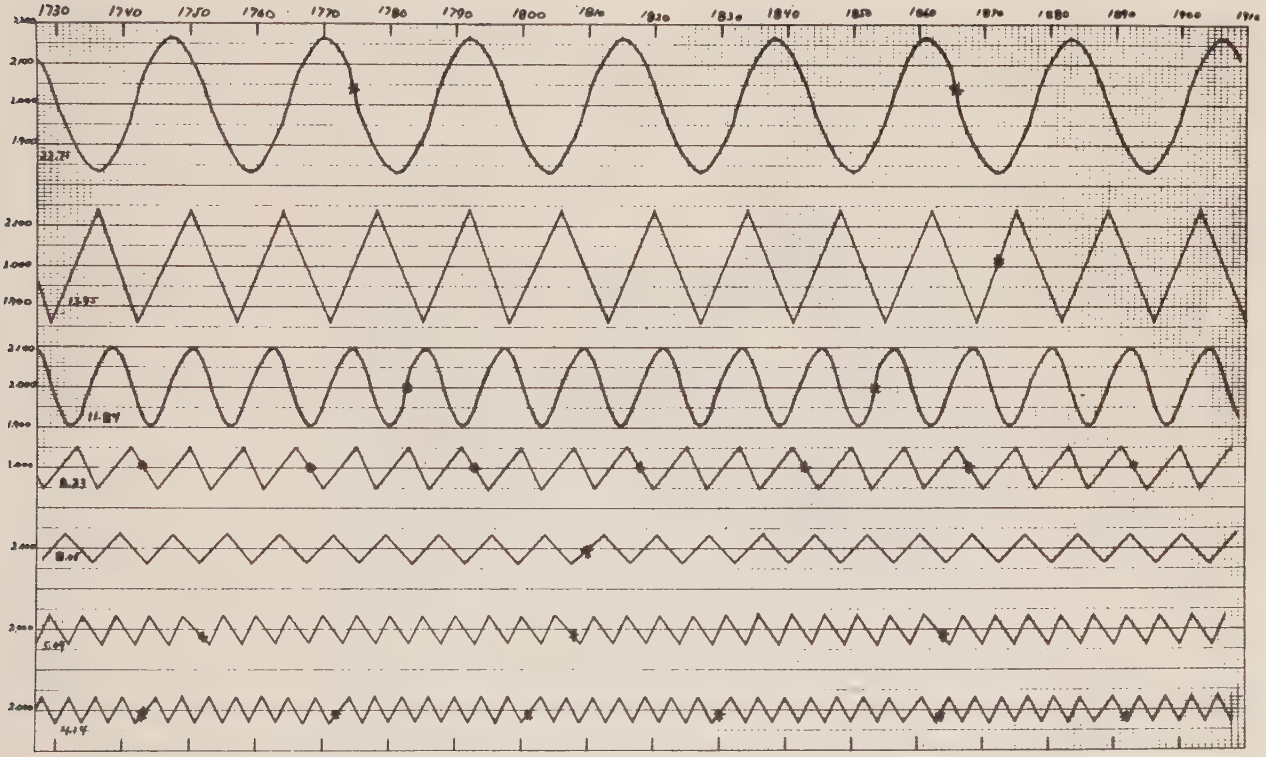

FIGURE 23. THE SHAPE AND AMPLITUDE DETERMINED FOR THE SEVEN CYCLES IS ILLUSTRATED HERE. THE ASTERISKS (*) MARK POSITIONS WHERE THE LENGTH OF THE CYCLE HAS BEEN ADJUSTED FOR THE CALENDAR YEAR. THUS, AN ADJUSTMENT FOR FITTING AN 8.05-YEAR CYCLE TO AN 8-YEAR CALENDAR LENGTH WOULD NEED TO OCCUR BUT ONCE IN TWENTY REPETITIONS OF THE CYCLE.

ceeding and succeeding years as to raise a suspicion that records were not well kept, at least in some years. Although they may be real and may reflect the actual situation at the time, the fact that these variations distort low values more than high values suggests rather strongly omission of bag records rather than the addition of non-existant ones.

But the evident regularity in the first sixty years indicates a possible cycle in the eleven or twelve year range; probable continuance may be noted also for the rest of the series. A moving average of eleven years was used and the deviations plotted from it (Figure 27). A 12-year time chart (Figure 28) shows that a cycle of about 11.75 years may be indicated by the band of highs and about 12.3 years by the lows. The two together average a little more than 12 years. Because a graduated scale of 12.3 years indicates probable rhythm of a little less than the scale, I set up a 12.25 year periodic table (Table 16) that shows little if any slippage between the two halves. Because of the many probable distortions in the record keeping, I made a five-item moving average median to obtain an average median of the two sections of the periodic table (Figure 29).

In order to measure the amplitude and timing, it is necessary to minimize or eliminate possible shorter cycles of about half the length of the table. I accordingly made a 6-year moving average of the average median of the table.

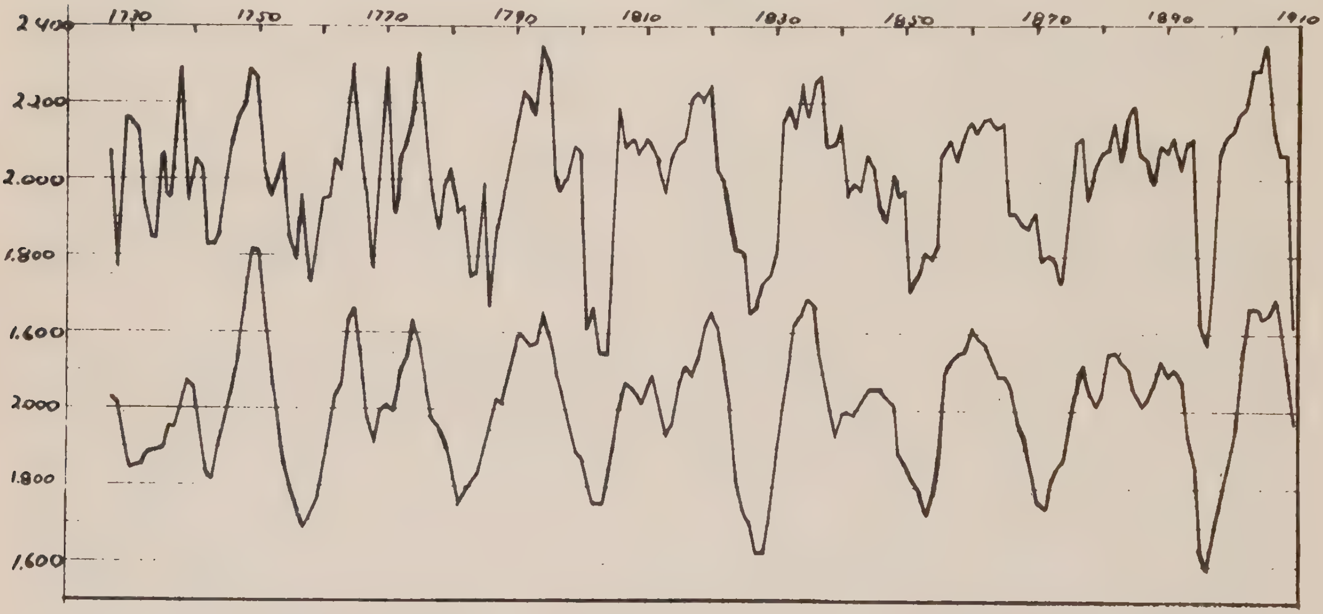

FIGURE 24. THE MANIFEST CYCLE COMPOSED OF THE SEVEN DERIVATIONS OF FIGURE 23 SHOWS A RESEMBLANCE TO THE ORIGINAL (TOP) DEVIATIONS FROM THE 23-YEAR MOVING AVERAGE.

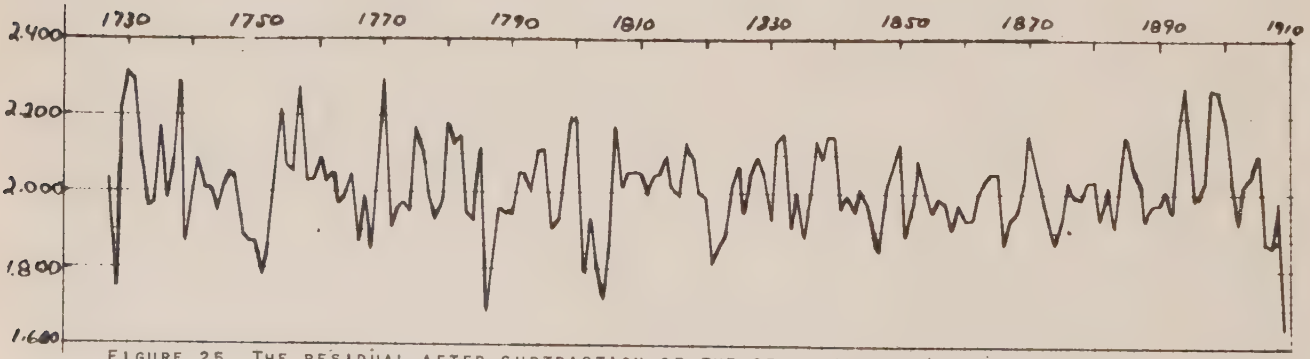

FIGURE 25. THE RESIDUAL AFTER SUBTRACTION OF THE SEVEN CYCLES (DEVIATIONS MINUS THE MANIFEST CYCLE OF FIGURE 24) SHOWS THE PRESENCE OF ADDITIONAL AND UNANALYZED CYCLES.

Because the 6-year moving average is 49% of 12.25 years, it will retain about 65% of the amplitude of a sine curve (which the 12.25-year cycle appears to be) as shown by the Foote Chart. Each value of the cycle may be restored by a restoration factor of 1.54 (65:100). This has been done as shown in Table 17 and plotted in Figure 30. The restored amplitude has a range of 2.126 to 1.972, which may be centered between 2.127 and 1.973 by establishing a new axis 0.001 higher than the old one.

The amplitude of 2.127 at the high and 1.873 at the low may be restored in turn for loss to the 11-year moving average by a simple computation. The moving average of 11-years is 89.8% of

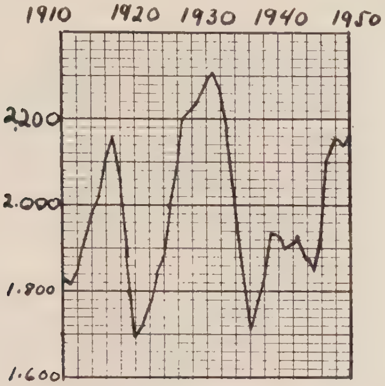

FIGURE 26. THE MANIFEST CYCLE OF FIGURE 24 HAS BEEN EXTENDED BEYOND THE END OF THE DATA. AS THE BASIS OF A FORECAST IT SUFFERS FROM THE PROBABLE PRESENCE OF UNANALYZED CYCLES IN THE RESIDUAL (FIGURE 25) AND ABSENCE OF THE TREND AS IN FIGURE 1. RANDOM FLUCTUATIONS PROBABLY OCCUR IN THE RESIDUAL ALSO. THE PROCEDURE FOR MAKING A FORECAST WOULD BE TO EXTEND THE EVIDENT DIRECTION OF THE TREND TO OBTAIN POSSIBLE FUTURE VALUES. THE COMBINED CYCLE OF FIGURE 26 AND ANY ADDITIONAL CYCLES MEASURED MAY THUS BE ADDED TO THE TREND ("WRAPPED AROUND" IT). IF DATA SUBSEQUENT THOSE OF TABLE 1 WERE FOUND, THEIR COMPARISON WITH THIS MANIFEST CYCLE WOULD BE VERY MUCH WORTH WHILE IN TESTING THE VALIDITY OR CONTINUANCE OF THESE CYCLES.

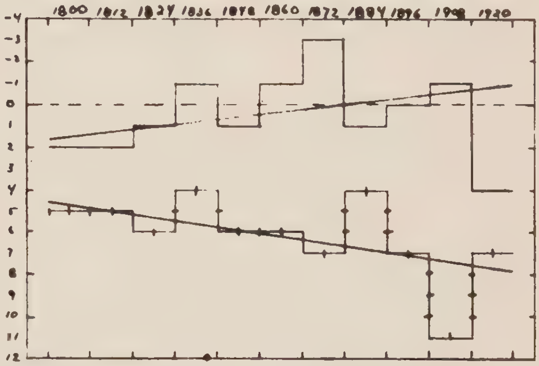

FIGURE 28. A TWELVE YEAR TIME CHART SHOWS THE POSSIBLE PRESENCE OF A CYCLE OF ABOUT 11 3/4 YEARS IN THE BAND OF HIGHS (TOP) AND ONE OF ABOUT 12 1/4 YEARS IN THE BAND OF LOWS (BOTTOM).

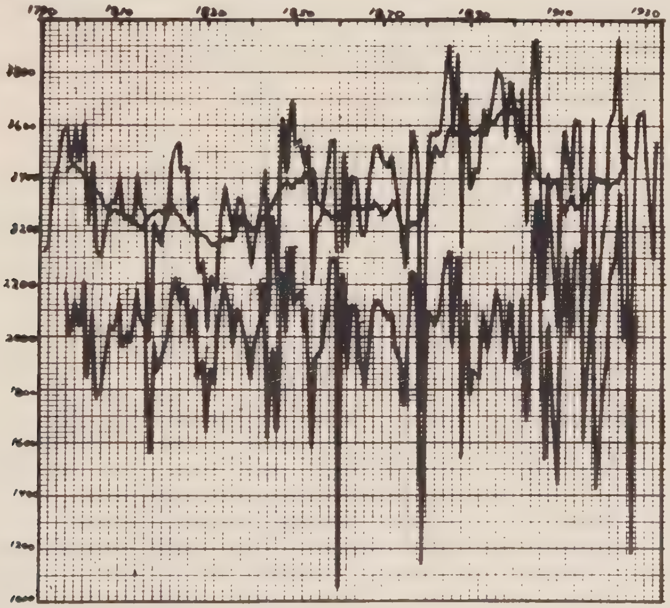

FIGURE 27. THE PARTRIDGE RECORD FROM A NORFOLK, ENGLAND ESTATE (IN LOGARITHMS) IS SHOWN WITH AN ELEVEN-YEAR MOVING AVERAGE. THE DEVIATIONS FROM THE ELEVEN-YEAR MOVING AVERAGE ARE SHOWN.

the cycle length. By reference to the Foote Chart for a sine curve, it can be determined that the 11-year moving average retains 11% of the amplitude. The loss may be restored by a correction factor of 1.12 (89:100) to give a new amplitude at the high of logarithm 2.142 and logarithm 1.858 at the low. By reference to a logarithm table, the amplitude may be converted to whole numbers which may be read as 138.7% of the trend at the high and 72.2% at the low. Whether this cycle is the alpha cycle can not be determined until the data have been tested for other cycles. But its amplitude would indicate either an alpha or beta cycle.

The low seems to be at position-2.5 which would put the first high in the spring of 1795 (1794.5). The high seems to fall in position-7.5, which would indicate the first high as in the spring of 1800 (1799.5). If this behavior continued, the most recent low should fall in the summer of 1954 (1953.75) and the most recent high in the spring of 1947 (1946.5).

Table 16 shows the data for the Partridge, the moving average, and the deviations from it. The average behavior of a 12.25 year cycle as indicated by Table 17 has been subtracted to give a residual. The residual suggests the presence of several cycle elements, especially one of about six years (possibly a little shorter).

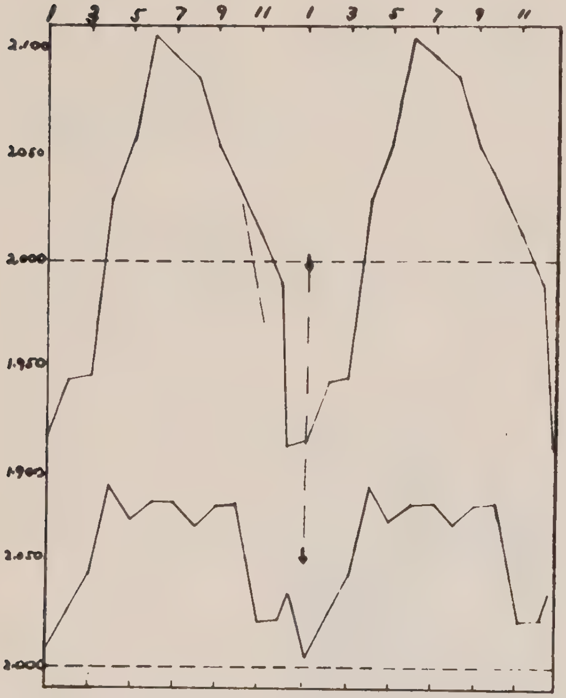

FIGURE 29. A 12.25-YEAR PERIODIC TABLE SHOWS LITTLE IF ANY SLIPPAGE BETWEEN THE TWO HALVES OF THE TABLE, WHICH INDICATES THE TRUE LENGTH OF THE CYCLE AS ABOUT 12.25 YEARS LONG.

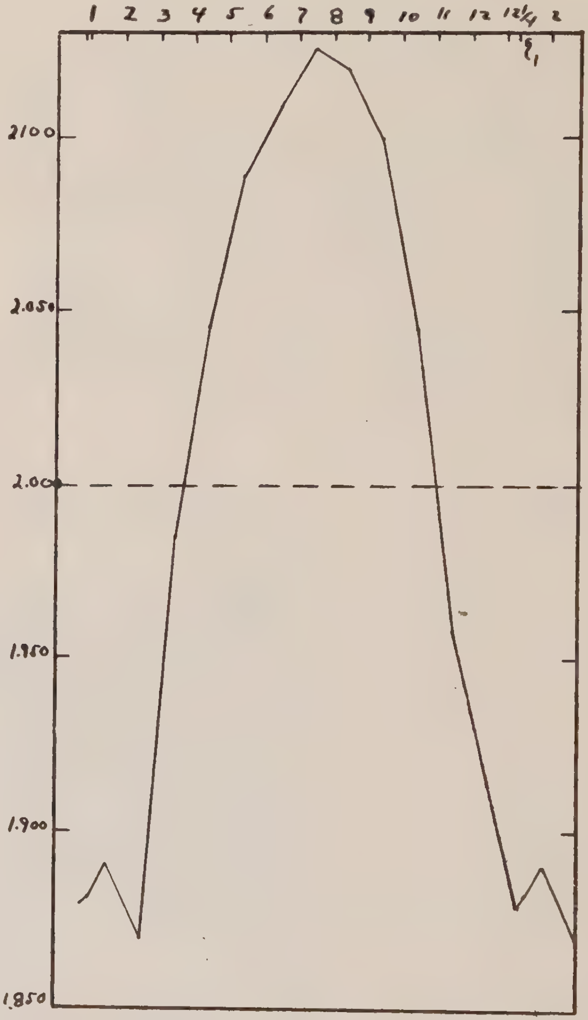

FIGURE 30. THE AMPLITUDE OF THE 12.25-YEAR CYCLE HAS BEEN RESTORED FOR LOSS TO A 6-YEAR MOVING AVERAGE OF THE AVERAGE MEDIAN OF THE 12.25-YEAR PERIODIC TABLE.

TABLE 1

European Partridge at Krumau

Year	Number Bagged	Logarithms of Number Bagged	23-Year Moving Average (extended)	Deviations from 23-Year Moving Average	11-Year Moving Average of Deviations from 23-Year Moving Average	22.71-Year Cycle	Residual (Deviations less 22.71-Year Cycle)
1727	63	1.799	1.730	2.069		2.107	1.962
1728	33	1.519	1.750	1.769		2.087	1.682
1729	87	1.940	1.780	2.160		2.047	2.113
1730	91	1.959	1.800	2.159		1.993	2.166
1731	95	1.978	1.840	2.138		1.953	2.185
1732	64	1.806	1.860	1.946	1.998	1.918	2.028
1733	56	1.748	1.900	1.848	2.019	1.887	1.961
1734	61	1.785	1.930	1.855	2.035	1.860	1.995
1735	105	2.021	1.960	2.061	2.025	1.843	2.218
1736	87	1.940	1.990	1.950	2.013	1.835	2.115
1737	110	2.041	2.020	2.021	1.985	1.840	2.181
1738	227	2.356	2.057	2.299	1.974	1.865	2.434
1739	108	2.033	2.090	1.943	1.974	1.893	2.050
1740	152	2.182	2.125	2.057	1.987	1.925	2.132
1741	148	2.170	2.140	2.030	1.991	1.968	2.062
1742	96	1.982	2.157	1.825	2.010	2.026	1.799
1743	101	2.004	2.178	1.826	2.026	2.072	1.754
1744	112	2.049	2.198	1.851	2.024	2.103	1.748
1745	163	2.212	2.219	1.993	2.054	2.132	1.861
1746	222	2.346	2.245	2.101	2.050	2.154	1.947
1747	261	2.417	2.253	2.164	2.044	2.165	1.999
1748	289	2.461	2.267	2.194	2.060	2.160	2.034
1749	367	2.565	2.283	2.282	2.082	2.142	2.140
1750	359	2.555	2.287	2.268	2.082	2.117	2.151
7151	214	2.330	2.309	2.021	2.064	2.087	1.934
1752	192	2.283	2.325	1.958	2.051	2.047	1.911
1753	224	2.350	2.350	2.000	2.012	1.993	2.007
1754	287	2.458	2.488	2.070	1.975	1.953	2.117
1755	185	2.267	2.414	1.853	1.944	1.918	1.935
1756	167	2.233	2.435	1.788	1.916	1.887	1.901
1757	252	2.401	2.441	1.960	1.919	1.860	2.100
1758	154	2.188	2.453	1.735	1.926	1.843	1.892
1759	182	2.260	2.475	1.785	1.945	1.835	1.950
1760	264	2.422	2.478	1.944	1.967	1.840	2.104
1761	276	2.441	2.483	1.958	1.982	1.865	2.093
1762	352	2.547	2.490	2.057	1.998	1.983	2.164
1763	348	2.542	2.511	2.031	1.980	1.925	2.106
1764	574	2.759	2.540	2.219	2.008	1.968	2.251
1765	726	2.861	2.558	2.303	2.054	2.026	2.277
1766	388	2.587	2.563	2.026	2.050	2.072	1.954
1767	342	2.534	2.572	1.962	2.059	2.103	1.859
1768	222	2.346	2.585	1.761	2.062	2.154	1.607
1769	133	2.636	2.596	2.040	2.076	2.165	1.875
1770	803	2.905	2.613	2.292	2.086	2.160	2.132
1771	339	2.530	2.627	1.903	2.072	2.142	1.671
1772	476	2.678	2.627	2.051	2.066	2.117	1.934
1773	524	2.719	2.627	2.092	2.058	2.087	2.005
1774	655	2.816	2.632	2.184	2.069	2.047	2.137
1775	900	2.954	2.623	2.331	2.068	1.993	2.338
1776	584	2.766	2.614	2.152	2.034	1.953	2.199
1777	366	2.563	2.605	1.958	2.036	1.918	2.040
1778	308	2.489	2.611	1.878	2.009	1.887	1.991
1879	320	2.505	2.624	1.881	1.778	1.860	2.021
1780	472	2.674	2.648	2.026	1.960	1.843	2.183
1781	374	2.573	2.658	1.915	1.900	1.835	2.080
1782	382	2.583	2.655	1.927	1.872	1.840	2.087
1783	268	2.428	2.675	1.753	1.877	1.865	1.888
1784	278	2.444	2.688	1.756	1.892	1.893	1.863
1785	472	2.674	2.687	1.987	1.916	1.925	2.062
1786	222	2.346	2.680	1.666	1.946	1.968	1.698
1787	355	2.550	2.671	1.879	1.962	2.026	1.853
1788	445	2.648	2.673	1.975	1.984	2.072	1.903
1789	543	2.735	2.683	2.052	2.039	2.103	1.949
1790	657	2.818	2.678	2.140	2.088	2.132	2.008
1791	813	2.910	2.674	2.236	2.089	2.154	2.082
1792	735	2.866	2.658	2.208	2.117	2.165	2.043
1793	665	2.823	2.646	2.177	2.130	2.160	2.017
1794	987	2.994	2.642	2.352	2.140	2.142	2.210
1795	913	2.960	2.665	2.295	2.141	2.117	2.178
1796	485	2.686	2.683	2.003	2.093	2.087	1.916
1797	462	2.665	2.692	1.973	2.042	2.047	1.926
1798	538	2.731	2.715	2.016	1.982	1.993	2.023
1799	653	2.815	2.732	2.083	1.925	1.953	2.130
1800	647	2.811	2.743	2.068	1.868	1.918	2.150
1801	230	2.362	2.749	1.613	1.859	1.887	1.726
1802	262	2.418	2.748	1.670	1.866	1.860	1.810
1803	198	2.297	2.748	1.549	1.878	1.843	1.706
1804	232	2.305	2.752	1.553	1.884	1.835	1.718
1805	308	2.489	2.759	1.730	1.886	1.840	1.890
1806	889	2.949	2.763	2.186	1.888	1.865	2.321
1807	715	2.854	2.769	2.085	1.928	1.893	2.192
1808	785	2.895	2.786	2.109	1.956	1.925	2.184
1809	762	2.882	2.806	2.076	2.003	1.968	2.108
1810	838	2.923	2.814	2.109	2.052	2.026	2.083
1811	794	2.900	2.817	2.083	2.086	2.072	2.011
1812	752	2.876	2.817	2.059	2.088	2.103	1.956
1813	648	2.812	2.833	1.979	2.101	2.132	1.847
1814	807	2.907	2.847	2.060	2.110	2.154	1.906
1815	893	2.951	2.860	2.091	2.125	2.165	1.926
1816	958	2.981	2.874	2.107	2.118	2.160	1.947
1817	1231	3.090	2.883	2.207	2.109	2.142	2.065
1818	1269	3.103	2.872	2.231	2.094	2.117	2.114
1819	1183	3.073	2.868	2.205	2.080	2.087	2.118
1820	1317	3.120	2.877	2.243	2.057	2.047	2.196
1821	822	2.915	2.887	2.028	2.018	1.993	2.035
1822	765	2.884	2.894	1.990	1.979	1.953	2.037
1823	636	2.803	2.906	1.897	1.935	1.918	1.979
1824	545	2.736	2.916	1.820	1.891	1.887	1.933
1825	555	2.744	2.933	1.811	1.856	1.860	1.951
1826	401	2.603	2.947	1.656	1.847	1.843	1.813
1827	425	2.628	2.951	1.677	1.862	1.835	1.842
1828	475	2.677	2.955	1.722	1.875	1.840	1.882
1829	515	2.712	2.956	1.756	1.906	1.865	1.891
1830	585	2.767	2.948	1.819	1.938	1.893	1.926
1831	1221	3.087	2.943	2.144	1.977	1.925	2.219
1832	1335	3.125	2.935	2.190	2.033	1.968	2.222
1833	1165	2.066	2.937	2.129	2.070	2.026	2.103
1834	1222	3.187	2.940	2.247	2.104	2.072	2.175
1835	1278	3.107	2.943	2.164	2.140	2.103	2.061
1836	1559	3.193	2.946	2.247	2.151	2.132	2.115
1837	1685	3.227	2.955	2.272	2.137	2.154	2.118
1838	1115	3.047	2.966	2.081	2.117	2.165	1.916
1839	1189	3.075	2.977	2.098	2.111	2.160	1.938
1840	1311	3.118	2.974	2.144	2.090	2.142	2.002
1841	836	2.922	2.972	1.950	2.069	2.117	1.833
1842	895	2.952	2.971	1.981	2.036	2.087	1.894
1843	845	2.927	2.955	1.972	2.013	2.047	1.925
1844	962	2.983	2.939	2.060	2.002	1.993	2.067
1845	898	2.953	2.936	2.017	1.990	1.953	2.063
1846	737	2.867	2.928	1.939	1.950	1.918	2.021
1847	642	2.808	2.923	1.885	1.933	1.887	1.998
1848	858	2.933	2.917	2.016	1.917	1.860	2.156
1849	732	2.865	2.910	1.955	1.901	1.843	2.112
1850	768	2.885	2.910	1.975	1.881	1.835	2.140
1851	412	2.615	2.911	1.704	1.885	1.840	1.864
1852	463	2.666	2.910	1.756	1.900	1.865	1.891
1853	537	2.730	2.918	1.812	1.915	1.893	1.919
1854	522	2.718	2.925	1.793	1.924	1.925	1.868
1855	578	2.762	2.925	1.837	1.941	1.968	1.869
1856	972	2.988	2.923	2.065	1.955	2.026	2.039
1857	1053	3.022	2.922	2.100	1.996	2.072	2.028
1858	947	2.976	2.924	2.052	2.033	2.103	1.949
1859	1121	3.050	2.932	2.118	2.062	2.132	1.986
1860	1179	3.072	2.930	2.142	2.095	2.154	1.988
1861	1129	3.053	2.931	2.122	2.102	2.165	1.957
1862	1232	3.091	2.932	2.159	2.088	2.160	1.999
1863	1268	3.103	2.943	2.160	2.069	2.142	2.018
1864	1254	3.098	2.959	2.139	2.052	2.117	2.022
1865	1346	3.129	2.982	2.147	2.034	2.087	2.060
1866	837	2.923	3.007	1.916	2.003	2.047	1.869
1867	872	2.941	3.024	1.917	1.974	1.993	1.924
1868	828	2.918	3.036	1.882	1.940	1.918	1.964
1869	835	2.922	3.050	1.872	1.901	1.887	1.985
1870	965	2.985	3.066	1.919	1.877	1.860	2.059
1871	761	2.881	3.084	1.797	1.872	1.843	1.954
1872	795	2.900	3.098	1.802	1.890	1.835	1.967
1873	805	2.906	3.117	1.789	1.893	1.840	1.949
1874	743	2.871	3.137	1.734	1.906	1.865	1.869
1875	1057	3.024	3.152	1.872	1.925	1.893	1.979
1876	1805	3.256	3.167	2.089	1.940	1.925	2.164
1877	1966	3.294	3.180	2.114	1.971	1.968	2.146
1878	1434	3.157	3.206	1.951	1.993	2.026	1.925
1879	1832	3.263	3.231	2.032	2.026	2.072	1.960
1880	2168	3.336	3.259	2.077	2.067	2.103	1.974
1881	2316	3.365	3.285	2.080	2.085	2.132	1.948
1882	2862	3.457	3.311	2.146	2.082	2.154	1.992
1883	2438	3.387	3.343	2.044	2.072	2.165	1.879
1884	3143	3.497	3.353	2.144	2.084	2.160	1.984
1885	3557	3.551	3.361	2.190	2.087	2.142	2.048
1886	2779	3.444	3.377	2.067	2.091	2.117	1.950
1887	2847	3.454	3.399	2.055	2.086	2.087	1.968
1888	2553	3.407	3.414	1.993	2.081	2.047	1.946
1889	3355	3.526	3.427	2.099	2.087	1.993	2.106
1890	3245	3.511	3.447	2.064	2.040	1.953	2.111
1891	3794	3.579	3.463	2.116	1.985	1.918	2.198
1892	3193	3.504	3.479	2.025	1.954	1.887	2.138
1893	3895	3.591	3.493	2.098	1.955	1.860	2.238
1894	4093	3.612	3.506	2.106	1.965	1.843	2.263
1895	1390	3.143	3.512	1.631	1.968	1.835	1.796
1896	1218	3.085	3.509	1.576	1.978	1.840	1.736
1897	1701	3.231	3.503	1.728	1.984	1.865	1.863
1898	3523	3.547	4.384	2.064	2.008	1.893	2.172
1899	3904	3.591	3.480	2.111	2.025	1.925	2.186
1900	3917	3.593	3.460	2.113	2.047	1.968	2.165
1901	4126	3.616	3.450	2.166	2.094	2.026	2.140
1902	4236	3.627	3.440	2.187	2.138	2.072	2.115
1903	5105	3.708	3.420	2.288	2.168	2.103	2.185
1904	4910	3.691	3.410	2.281	2.129	2.132	2.149
1905	5588	3.747	3.400	2.347		2.154	2.203
1906	3378	3.529	3.380	2.149		2.165	1.984
1907	2707	3.432	3.370	2.062		2.160	1.902
1908	2637	3.421	3.360	2.061		2.142	1.919
1909	926	2.967	3.350	1.617		2.117	1.500

TABLE 2

22.71-Year Periodic Table of Partridge. Deviations of Logarithms from Their 23-year Moving Average.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	22.71
1731	1.998	2.019	2.035	2.025	2.013	1.985	1.974	1.974	1.987	1.991	2.010	2.026	2.024	2.054	2.050	2.044	2.060	2.082	2.082	2.064	2.051	2.012	1.975
1754	1.944	1.916	1.919	1.926	1.945	1.967	1.982	1.998	1.980	2.008	2.054	2.050	2.059	2.062	2.076	2.086	2.072	2.066	2.058	2.069	2.068	2.034	2.036
1776	2.036	2.009	1.978	1.960	1.900	1.872	1.877	1.892	1.916	1.935	1.962	1.984	2.039	2.088	2.089	2.117	2.130	2.140	2.141	2.093	2.042	1.982	1.925
1799	1.868	1.859	1.866	1.878	1.864	1.886	1.888	1.928	1.956	2.003	2.052	2.086	2.088	2.101	2.110	2.125	2.118	2.109	2.094	2.080	2.057	2.018	1.979
1822	1.935	1.891	1.856	1.847	1.862	1.875	1.906	1.938	1.977	2.033	2.070	2.104	2.140	2.151	2.137	2.117	2.111	2.090	2.069	2.036	2.013	2.002	1.990
1845	1.950	1.933	1.917	1.901	1.881	1.885	1.900	1.915	1.924	1.941	1.955	1.996	2.033	2.062	2.095	2.102	2.088	2.069	2.052	2.034	2.003	1.974	1.940
1867	1.940	1.901	1.877	1.872	1.890	1.893	1.906	1.925	1.940	1.971	1.993	2.026	2.067	2.085	2.082	2.072	2.084	2.087	2.901	2.086	2.081	2.087	2.040
Average Median	1.945	1.917	1.904	1.902	1.891	1.884	1.929	1.930	1.958	1.955	2.052	2.031	2.055	2.078	2.092	2.102	2.094	2.086	2.081	2.071	2.050	1.991	1.981

TABLE 3

14-Year Periodic Table of Deviations of Logarithms from 23-year Moving Average.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1726	1.962	1.682	2.113	2.116	2.185	2.028	1.961	1.995	2.218	2.115	2.181	2.434	2.050	2.132
1740	2.062	1.799	1.754	1.748	1.861	1.947	1.999	2.034	2.140	2.151	1.934	1.911	1.911	2.007
1754	1.934	1.901	2.100	1.892	1.950	2.104	2.093	2.164	2.106	2.251	2.277	1.954	1.859	1.607
1768	1.875	2.132	1.761	1.934	2.005	2.137	2.338	2.199	2.040	1.991	2.021	2.183	2.038	2.087
1782	1.888	1.863	2.062	1.698	1.853	1.903	1.949	2.008	2.082	2.043	2.017	2.210	2.178	1.916
1796	1.926	2.023	2.130	2.150	1.726	1.810	1.806	1.718	1.890	2.321	2.192	2.184	2.108	2.083
1810	2.011	1.956	1.847	1.906	1.926	1.947	2.065	2.114	2.118	2.196	2.035	2.037	1.979	1.923
1824	1.951	1.813	1.842	1.882	1.891	1.926	2.219	2.222	2.103	2.175	2.061	2.115	2.118	1.916
1838	1.938	2.002	1.833	1.894	1.925	2.067	2.064	2.021	1.998	2.156	2.112	2.140	1.864	1.891
1852	1.919	1.868	1.869	2.039	2.028	1.949	1.986	1.988	1.957	1.999	2.018	2.022	2.060	1.869
1866	1.924	1.964	1.985	2.059	1.954	1.967	1.947	1.869	1.979	2.164	2.146	1.925	1.960	1.974
1880	1.948	1.992	1.879	1.984	2.048	1.950	1.968	1.946	2.106	2.111	2.198	2.138	2.238	2.263
1894	1.796	1.736	1.836	2.172	2.186	2.165	2.140	2.115	2.185	2.149	2.203	1.984	1.902	1.919
1726–1824 Average Median	1.942	1.882	1.954	1.899	1.908	1.947	2.032	2.074	2.104	2.163	2.048	2.149	2.044	2.003
1796–1894 Average Median	1.931	1.960	1.858	2.012	1.940	1.950	2.025	2.004	2.050	2.160	2.129	2.076	2.020	1.921
1726–1894 Average Median	1.933	1.908	1.865	1.941	1.943	1.955	2.016	2.021	2.097	2.152	2.106	2.097	2.032	1.939

TABLE 4

11.84-Year Periodic Table of Deviations of logarithms from the 23-year moving average (22.71 and 13.95-year cycles removed).

Year	1	2	3	4	5	6	7	8	9	10	11	11.84
1726	2.043	1.787	2.253	2.254	2.234	2.046	1.945	1.938	2.123	1.975	2.066	2.358
1738	2.040	2.176	2.143	1.904	1.894	1.836	1.910	1.965	1.983	1.977	2.045	2.011
1750	1.819	1.835	1.997	2.161	2.016	2.006	2.240	1.980	1.999	2.122	2.077	2.107
1762	2.011	2.111	2.162	1.878	1.849	1.651	1.956	2.237	1.901	2.022	2.054	2.155
1773	2.155	2.322	2.142	1.945	1.851	1.906	2.107	2.070	2.131	1.969	1.968	2.202
1785	1.786	1.902	1.921	1.933	1.951	1.987	1.903	1.902	2.134	2.168	1.860	2.007
1797	2.128	2.270	2.238	1.775	1.828	1.690	1.661	1.795	2.181	2.177	2.108	2.098
1809	2.127	2.092	2.061	1.987	1.994	1.975	1.965	2.049	2.057	2.023	2.056	1.920
1821	1.967	1.969	1.977	2.032	1.918	1.982	1.970	1.940	1.944	2.203	2.165	2.008
1833	2.035	1.946	2.039	2.108	1.860	1.919	2.107	1.973	1.982	1.974	2.085	2.048
1844	2.048	1.964	1.903	2.016	1.997	2.064	1.854	1.935	2.000	1.973	2.009	2.127
1856	2.077	1.967	1.970	1.931	1.862	1.859	1.903	1.946	2.050	1.913	2.005	2.069
1868	2.125	2.147	2.033	1.985	1.933	1.812	1884	2.024	2.131	1.849	1.950	2.018
1880	2.029	2.097	2.019	2.072	2.097	1.934	1.911	1.851	1.966	1.996	2.122	2.128
1892	2.282	2.334	1.901	1.876	1.951	2.221	2.204	2.149	2.083	2.020	2.045	2.134
1726-1809 Average Median	2.042	2.102	2.143	1.939	1.922	1.940	1.950	1.972	2.090	2.022	2.055	2.102
1809-1892 Av erage Median	2.062	2.030	1.998	2.002	1.942	1.954	1.938	1.960	2.006	1.985	2.050	2.058
1726-1892 Average Median	2.081	2.053	2.030	1.972	1.934	1.920	1.934	1.961	2.036	1.998	2.052	2.091
3-year moving Average	2.075	2.055	2.018	1.766	1.943	1.930	1.939	1.978	1.998	2.028	2.048	2.075

TABLE 5

8-Year Periodic Table of Deviations of Logarithms from their 23-year moving average (22.71 and 13.95-year cycles have been removed).

Year	1	2	3	4	5	6	7	8
1726	2.043	2.253	2.254	2.234	2.046	1.945	1.938	1.787
1734	2.123	1.975	2.066	2.358	2.040	2.176	2.143	1.904
1742	1.894	1.836	1.910	1.965	1.983	1.977	2.044	2.011
1750	1.918	1.835	1.997	2.161	2.016	2.006	2.240	1.980
1758	1.999	2.122	2.077	2.107	2.011	2.111	2.162	1.878
1766	1.849	1.651	1.956	2.237	1.901	2.022	2.054	2.155
1774	2.322	2.142	1.945	1.851	1.906	2.107	2.070	2.131
1782	1.969	1.968	2.202	1.786	1.902	1.921	1.933	1.951
1790	1.987	1.903	1.902	2.134	2.168	1.860	2.007	2.128
1798	2.270	2.238	1.775	1.828	1.690	1.661	1.795	2.181
1806	2.177	2.108	2.098	2.127	2.092	2.061	1.987	1.994
1814	1.975	1.965	2.049	2.057	2.023	2.056	1.920	1.967
1822	1.969	1.977	2.032	1.918	1.982	1.970	1.940	1.944
1830	2.203	2.165	2.008	2.035	1.946	2.039	2.108	1.860
1838	1.919	2.107	1.973	1.982	1.974	2.085	2.048	1.964
1846	1.903	2.016	1.997	2.064	1.854	1.935	2.000	1.973
1854	2.009	2.127	2.077	1.967	1.970	1.931	1.862	1.859
1862	1.903	1.947	2.050	1.913	2.005	2.069	2.125	2.147
1870	2.033	1.985	1.933	1.812	1.884	2.024	2.131	1.849
1878	1.950	2.018	2.029	2.097	2.019	2.072	2.097	1.934
1886	1.911	1.851	1.966	1.996	2.122	2.128	2.282	2.334
1894	1.901	1.876	1.951	2.221	2.204	2.149	2.083	2.020
1902	2.045	2.134	2.127	1.974	1.846	2.000	1.605	
1726-1814 Average Median	2.001	1.924	2.017	2.106	2.008	2.033	3.023	1.988
1814-1902 Average Median	1.953	1.999	2.017	1.997	1.983	2.032	2.057	1.962

TABLE 7

4-Year Periodic Table of Deviations of logarithms from their 23-year moving average (22.71 and 13.95-year cycles removed).

Year	1	2	3	4
1726	2.043	1.787	2.253	2.254
1730	2.234	2.046	1.945	1.938
1734	2.231	1.975	2.066	2.358
1738	2.040	2.176	2.143	1.904
1742	1.894	1.836	1.910	1.905
1746	1.983	1.977	2.045	2.011
1750	1.819	1.835	1.997	2.161
1750	2.016	2.006	2.240	1.980
1758	1.999	2.122	2.077	2.107
1762	2.011	2.111	2.162	1.878
1766	1.849	1.651	1.956	2.237
1770	1.901	2.022	2.054	2.155
1774	2.322	2.142	1.945	1.851
1778	1.906	2.107	2.070	2.131
1782	1.969	1.968	2.202	1.786
1786	1.902	1.921	1.933	1.951
1790	1.987	1.903	1.902	2.134
1794	2.168	1.860	2.007	2.128
1798	2.270	2.238	1.775	1.828
1802	1.609	1.661	1.795	2.181
1806	2.177	2.108	2.098	2.127
1810	2,092	2.061	1.987	1.994
1814	1.975	1.965	2.049	2.057
1818	2.023	2.056	1.920	1.967
1822	1.969	1.977	2.032	1.918
1826	1.982	1.970	1.940	1.944
1830	2.203	2.165	2.008	2.035
1834	1.946	2.039	2.108	1.860
1838	1.919	2.107	1.973	1.982
1842	1.974	2.085	2.048	1.964
1846	1.903	2.016	1.997	2.064
1850	1.854	1.935	2.000	1.973
1854	2.009	2.127	2.077	1.967
1858	1.970	1.931	1.862	1.859
1862	1.903	1.946	2.050	1.913
1866	2.005	2.069	2.125	2.147
1870	2.033	1.985	1.933	1.812
1874	1.884	2.024	2.131	1.849
1878	1.950	2.018	2.029	2.097
1882	2.019	2.072	2.097	1.934
1886	1.911	1.851	1.966	1.996
1890	2.122	2.128	2.282	2.334
1894	1.901	1.876	1.951	2.221
1898	2.204	2.149	2.083	2.020
1902	2.045	2.134	2.127	1.974
1906	1.846	2.000	1.605	
1726-1814 average median	1.999	1.986	2.034	2.058
1814-1902 averge median	1.975	2.206	2.036	1.964

TABLE 6

Four-Year Halves of an Eight-Year Periodic Table. Deviations of logarithms from 23-year moving average (less 22.71 and 13.95-year cycles).

Average Medians	1	2	3	4
1726-1814	2.005	1.978	2.020	2.047
1814-1902	1.968	2.016	2.037	1.979

TABLE 8

Twenty-three cycle moving average of table 7. (Asterisk denotes low values.)

Year				
1770	2.016	1.977*	2.027	2.049
1774	2.015	1.989*	2.012	2.036
1778	2.004	1.986*	2.016	2.035
1782	1.998*	1.986*	2.010	2.017
1786	2.006	1.985*	2.005	2.023
1790	2.007	1.994*	2.013	2.018
1794	2.004	2.000	2.010	2.017
1798	2.011	2.011	2.012	2.008
1802	2.006	2.011	2.002	2.012
1806	2.000	2.003	1.998*	2.006
1810	2.000	2.004	1.995*	2.010
1814	2.005	2.016	1.991*	1.994*
1818	2.005	2.013	1.990*	1.983*
1822	1.991*	2.009	1.998*	1.996*
1826	1.997*	2.004	1.992*	1.982*
1830	1.993*	2.006	1.989*	1.985*
1834	1.995*	2.011	1.993*	1.991*
1838	1.996*	2.018	2.002	1.983*
1842	1.985*	2018	2.000	1.977*
1846	1.979*	2.013	2.022	1.999*
1850	1.988*	2.022	2.029	2.001
1854	1.989*	2.024	2.028	1.998*
1858	1.987*	2.027	2.034	1.955*

TABLE 9

4.13-Year Periodic Table of Deviations of logarithms from their 23-year moving average. (22.71 and 13.95-year cycles removed.)

Year	1	2	3	4	5
1726	2.043	1.787	2.253	2.254	2.234
1730	2.234	2.046	1.945	1.938	2.123
1734	2.123	1.975	2.066	2.358	2.040
1738	2.040	2.176	2.142	1.904	1.894
1743	1.836	1.910	1.965	1.983	1.977
1747	1.977	2.045	2.011	1.819	1.835
1751	1.835	1.997	2.161	2.016	2.006
1755	2.006	2.240	1.980	1.999	2.122
1759	2.122	2.077	2.107	2.011	2.111
1763	2.111	2.162	1.878	1.849	1.651
1767	1.651	1.956	2.237	1.901	2.022
1771	2.022	2.054	2.155	2.322	2.142
1776	1.945	1.851	1.906	2.107	2.070
1780	2.070	2.131	1.969	1.968	2.202
1784	2.202	1.786	1.902	1.921	1.933
1788	1.933	1.951	1.987	1.903	1.902
1792	1.902	2.134	2.168	1.860	2.007
1796	2.007	2.128	2.270	2.238	1.775
1800	1.775	1.828	1.690	1.661	1.795
1804	1.795	2.181	2.177	2.108	2.098
1809	2.117	2.092	2.061	1.987	1.994
1813	1.994	1.975	1.965	2.049	2.057
1817	2.057	2.023	2.056	1.920	1.967
1821	1.967	1.969	1.977	2.032	1.918
1825	1.918	1.982	1.970	1.940	1.944
1829	1.944	2.203	2.165	2.008	2.035
1833	2.035	1.946	2.039	2.108	1.960
1838*	1.919	2.107	1.973	1.982	1.974
1842	1.974	2.083	2.048	1.964	1.903
1846	1.903	2.016	1.997	2.064	1.254
1850	1.854	1.935	2.000	1.973	2.009
1854	2.009	2.127	2.077	1.967	1.970
1858	1.970	1.931	1.862	1.859	1.903
1862	1.903	1.946	2.050	1.913	2.005
1866	2.005	2.069	2.125	2.147	2.033
1871	1.985	1.933	1.812	1.884	2.024
1875	2.024	2.131	1.847	1.950	2.018
1879	2.018	2.029	2.097	2.019	2.072
1883	2.072	2.097	1.934	1.911	1.851
1887	1.851	1.966	1.996	2.122	2.128
1891	2.128	2.282	2.334	1.901	1.376
1895	1.876	1.951	2.221	2.204	2.144
1899	2.149	2.083	2.020	2.045	2.134
1904	2.127	1.974	1.846	2.000	1.605
1726-1813 Average Median	2.006	2.050	2.036	1.985	2.014
1817-1904 Average Median	1.980	2.020	2.010	1.987	1.972
1726-1904 Average Median	1.993	2.044	2.023	1.981	1.993

TABLE 10

5.1-Year Periodic Table of Deviations of Logarithms and their 23-year moving average (22.71, 13.95, 11.84, 8.05, and 4.14 cycles removed).

1726	1.978	1.717	2.252	2.314	2.284	2.082
1731	2.082	2.020	2.024	2.151	1.930	2.003
1736	2.003	2.281	1.918	2.049	2.122	1.984
1741	1.984	2.004	1.961	1.973	2.001	1.984
1746	1.984	1.907	1.930	1.924	1.784	1.797
1752	1.964	2.191	2.096	2.074	2.283	2.036
1757	2.036	2.057	2.109	1.982	2.000	1.919
1762	1.917	2.016	2.109	1.928	1.986	1.776
1767	1.776	2.019	2.273	1.902	1.955	1.771
1772	1.971	2.036	2.257	2.134	1.944	1.849
1777	1.849	1.956	2.205	2.145	2.155	1.956
1782	1.956	1.953	2.115	1.651	1.807	1.911
1787	1.911	1.963	2.008	2.112	2.046	1.958
1792	1.958	2.092	2.098	1.788	1.900	2.013
1797	2.013	2.232	2.285	1.825	1.897	1.726
1802	1.726	1.717	1.861	2.191	2.132	2.063
1808	2.041	2.024	1.965	2.021	2.047	2.063
1813	2.063	2.050	2.078	2.153	2.067	1.940
1818	1.940	1.954	1.824	1.864	1.881	1.994
1823	1.994	2.130	2.007	2.037	2.026	1.987
1828	1.987	1.937	2.172	2.088	1.939	1.982
1833	1.982	1.870	1.967	2.119	1.959	2.926
1838	2.026	2.188	2.047	2.022	1.923	1.951
1843	1.951	1.922	1.891	1.847	2.001	2.065
1848	2.065	2.183	1.941	1.959	2.017	1.952
1854	1.946	2.026	2.012	1.941	1.947	1.910
1859	1.910	1.912	1.976	2.001	2.020	2.046
1864	2.046	1.882	1.952	1.943	1.971	2.071
1869	2.071	2.062	2.058	2.008	1.919	1.989
1874	1.989	2.041	2.070	1.798	1.917	1.949
1879	1.949	1.942	2.041	2.028	2.083	2.115
1884	2.115	2.021	2.036	1.925	1.962	1.965
1889	1.965	2.069	2.005	2.160	2.226	1.900
1894	1.900	1.974	2.058	2.296	2.279	2.196
1899	2.196	2.054	1.937	1.982	2.095	2.062
1726–1827						
Average Median	1.924	2.020	2.097	2.035	2.000	1.964
1827–1899						
Average Median	1.988	2.024	2.010	2.004	1.982	1.988
1726–1899						
Average Median	1.970	2.030	2.050	2.015	1.995	1.969

TABLE 12

Probable Calendar Years of High of Partridge Cycles (for Krumau, Czecho-Slovakia, except 12.25 which is Norfolk, England).

4.14	5.09	8.05	8.33	11.84	13.95	22.71	12.25
1728.75	1729.55	1732.25	1733.75	1727.28	1736.75	1747.95	1800.25
1728	1729	1732	1733	1727	1736	1747	1812
1732	1734	1740	1742	1739	1750	1770	1824
1737	1739	1748	1750	1750	1764	1793	1837
1741	1744	1756	1758	1762	1778	1816	1849
1745	1749	1764	1767	1774	1792	1838	1861
1749	1754	1772	1775	1786	1806	1861	1873
1753	1760	1780	1783	1798	1820	1884	1886
1757	1765	1788	1792	1810	1834	1906	1898
1861	1770	1796	1800	1821	1848		1910
1866	1775	1804	1808	1833	1862		1922
1870	1780	1812	1817	1845	1876		
1774	1785	1820	1825	1857	1890		
1778	1790	1828	1833	1869	1904		
1782	1795	1836	1842	1881			
1786	1800	1844	1850	1893			
1790	1805	1853	1858	1904			
1794	1890	1861	1867				
1799	1816	1869	1875				
1803	1821	1877	1883				
1807	1826	1885	1892				
1811	1831	1893	1900				
1815	1836	1901	1908				
1819	1841	1909					
1823	1846						
1828	1851						
1832	1856						
1836	1861						
1840	1866						
1844	1872						
1848	1877						
1852	1882						
1857	1887						
1861	1892						
1865	1897						
1869	1902						
1873	1907						
1877							
1881							
1886							
1890							
1894							
1898							
1902							
1906							

TABLE 11

8.33-Year Periodic Table of Deviations of Logarithms from their 23-year moving average (22.71, 13.95, 11.84, 8.05, 5.09, and 4.14 cycles removed).

	1	2	3	4	5	6	7	8	8.33
1726	2.016	1.708	2.216	2.306	2.300	2.119	2.011	2.141	1.988
1734	2.141	1.946	2.040	2.272	1.882	2.059	2.138	2.021	1.995
1743	1.925	1.963	2.017	2.021	1.898	1.894	1.914	1.800	1.838
1751	1.838	2.001	2.182	2.182	2.064	2.299	2.073	2.048	2.073
1759	2.073	1.972	2.016	1.956	2.007	2.073	1.918	2.002	1.822
1768	2.010	2.237	1.892	1.971	2.008	2.027	2.221	2.124	1.960
1776	1.960	1.886	1.947	2.169	2.135	2.171	1.993	1.944	2.079
1784	2.079	1.641	1.823	1.948	1.954	1.972	2.102	2.062	1.995
1793	2.083	2.062	1.778	1.916	2.050	2.223	2.249	1.818	1.913
1801	1.913	1.763	1.708	1.825	2.181	2.148	2.100	2.023	1.988
1809	1.988	1.955	2.037	2.084	2.054	2.014	2.068	2.169	2.108
1818	1.977	1.955	1.788	1.854	1.897	2.031	2.121	1.971	2.027
1826	2.027	2.042	2.024	1.928	2.136	2.078	1.955	2.019	2.000
1834	1.931	2.109	1.975	2.063	2.179	2.011	2.012	1.937	1.980
1843	1.980	1.913	1.855	1.837	2.017	2.102	2.174	1.905	1.949
1851	1.949	2.033	1.989	1.937	1.990	2.002	1.957	1.986	1.901
1859	1.901	1.876	1.966	2.017	2.057	2.037	1.846	1.942	1.959
1868	2.008	2.062	2.026	2.048	2.024	1.956	1.980	2.005	2.060
1876	2.060	1.814	1.954	1.940	1.896	2.031	2.044	2.124	2.152
1884	2.152	2.012	2.000	1.915	1.978	2.002	2.060	1.969	2.150
1893	2.210	1.937	1.956	1.955	1.965	2.022	2.286	2.295	2.045
1901	1.901	1.972	2.111	2.099	1.877	1.789	2.039	1.639	
1726–1818									
Average Median	1.999	1.950	1.982	1.996	2.027	2.031	2.086	2.012	1.995
1809–1901									
Average Median	1.984	1.964	1.982	1.953	2.020	2.022	2.042	1.978	2.014
1726–1901									
Average Median	1.998	1.950	1.982	1.968	2.020	2.034	2.052	1.995	1.997

TABLE 13

Probable Calendar Years of Lows of Partridge Cycles (for Krumau, except 12.25, which is for Norfolk).

4.14	5.09	8.05	8.33	11.84	13.95	22.71	12.25
1730.82	1726.75	1728.25	1728.75	1733.05	1729.75	1736.65	1795.25
1730	1726	1728	1728	1733	1729	1736	1795
1734	1731	1736	1737	1744	1743	1759	1807
1739	1736	1744	1745	1756	1757	1782	1819
1743	1742	1752	1753	1768	1771	1804	1832
1747	1747	1760	1762	1780	1785	1827	1844
1751	1752	1768	1770	1792	1799	1850	1856
1755	1757	1776	1778	1804	1813	1872	1868
1759	1762	1784	1787	1815	1827	1895	1881
1763	1767	1792	1795	1827	1841		1893
1768	1772	1800	1803	1839	1855		1905
1772	1777	1808	1812	1851	1869		
1776	1782	1816	1820	1863	1883		
1780	1787	1824	1828	1875	1897		
1784	1792	1832	1837	1886			
1788	1798	1840	1845	1898			
1792	1803	1849	1853				
1797	1808	1857	1862				
1801	1813	1865	1870				
1805	1818	1873	1878				
1809	1823	1881	1887				
1813	1828	1889	1895				
1817	1833	1897	1903				
1821	1838	1905					
1826	1843						
1830	1848						
1834	1854						
1838	1859						
1842	1864						
1846	1869						
1850	1874						
1855	1879						
1859	1884						
1863	1889						
1867	1894						
1871	1899						
1875	1904						
1879	1909						
1884							
1888							
1892							
1896							
1900							
1904							
1908							

TABLE 17

Restoration of Amplitude of the 12.25-year Cycle for loss to the 6-year Moving Average.

Position		1	2	3	4	5	6	7	8	9	10	11	12	12.25
Average Median		1.749	1.924	1.980	2.064	2.072	2.159	1.984	2.082	2.087	2.109	2.038	2.082	1.775
6-year Moving Average	1.923	1.927	1.917	1.991	2.030	2.067	2.076	2.082	2.077	2.064	2.029	1.973	1.944	
Restored (x 1.54)	1.881	1.888	1.872	1.986	2.046	2.088	2.117	2.126	2.119	2.099	2.045	1.958	1.914	
Restored to Position (read off Figure 28)		1.883	1.881	1.930	2.016	2.069	2.104	2.122	2.123	2.110	2.073	2.003	1.937	1.888

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TABLE 15

Combined Seven Cycle Derivatives for Years Beyond Table 4.
(Asterisk indicates adjustment of cycle length to calendar length.)

Year	22.71 Cycle	13.95 Cycle	11.84 Cycle	8.33 Cycle	8.05 Cycle	5.09 Cycle	4.14 Cycle	Combined Cycles -12.000
1910	2.087	1.860	1.903	1.978	2.010	1.963	2.032	1.833-
1911	2.047	1.912	1.915	1.949	1.990	2.009	2.000	1.822-
1912	1.993	1.951	1.954	1.970	1.972	2.036	1.970	1.846-
1913	1.953	1.982	2.000	1.989	1.972	2.010	2.000	1.906-
1914	1.918	2.016	2.041	2.009	1.990	1.984	2.032	1.990-
1915	1.887	2.057	2.073	2.029	2.010	1.963	2.000	2.019-
1916	1.860	2.095	2.097	2.051	2.029	2.009	1.970	2.111-
1917	1.843	2.140	2.093	2.019	2.029	2.036	2.000	2.160-
1918	1.835	2.115	2.066	2.988*	2.010	2.010	2.032	2.056-
1919	1.840	2.076	2.011	1.978	1.990	1.984	2.000	2.879-
1920	1.865	2.010	1.960	1.949	1.972	1.963	1.970	1.689-
1921	1.893	1.956	1.921	1.970	1.972	2.009	1.997*	1.718-
1922	1.925	1.919	1.905	1.989	1.990	2.036	2.000	1.762-
1923	1.968	1.895	1.915	2.009	2.010	2.010	2.032	1.839-
1924	2.026	1.860	1.954	2.029	2.029	1.984	2.000	1.882-
1925	2.072	1.912	2.000	2.051	2.029	1.959*	1.970	1.993-
1926	2.103	1.951	2.041	2.019	2.010	1.963	2.000	2.087-
1927	2.132	1.982	2.073	1.978	1.990	2.009	2.032	2.196-
1928	2.154	2.016	2.097	1.949	1.972	2.036	2.000	2.224-
1929	2.165	2.057	2.093	1.970	1.972	2.010	1.970	2.237-
1930	2.160	2.095	2.066	1.989	1.990	1.984	2.000	2.284-
1931	2.142	2.140	2.011	2.009	2.010	1.963	2.032	2.307-
1932	2.117	2.115	1.960	2.029	2.029	2.009	2.000	2.259-
1933	2.087.	2.076	1.921	2.051	2.029	2.036	1.970	2.170-
1934	2.047	2.010	1.903	2.019	2.010	2.010	2.000	1.999-
1935	1.993	1.956	1.915	1.978	1.990	1.984	2.032	1.848-
1936	1.953	1.919	1.954	1.949	1.972	1.963	2.000	1.710-
1937	1.918	1.895	2.041*	1.970	1.972	2.009	1.970	1.775-
1938	1.887	1.860	2.073	1.989	1.990	2.036	2.000	1.835-
1939	1.860	1.912	2.097	2.009	2.010	2.010	2.032	1.930-
1940	1.843	1.951	2.093	2.029	2.029	1.984	2.000	1.929-
1941	1.835	1.982	2.066	2.051	2.029	1.963	1.970	1.896-
1942	1.840	2.016	2.011	2.000	2.010	2.009	2.000	1.905-
1943	1.865	2.057	1.960	1.988*	1.990	2.036	2.032	1.928-
1944	1.893	2.095	1.921	1.978	1.972	2.010	2.000	1.869-
1945	1.925	2.140	1.903	1.949	1.972	1.984	1.970	1.843-
1946	1.968	2.115	1.915	1.970	1.990	1.963	2.000	1.921-
1947	2.026	2.076	1.954	1.989	2.010	2.009	2.032	2.096-
1948	2.072	2.010	2.000	2.009	2.029	2.036	2.000	2.156-
1949	2.103	1.956	2.041	2.029	2.029	2.010	1.970	2.138-
1950	2.132	1.919	2.073	2.051	2.010	1.984	1.997*	2.166-
1951	2.154	1.895*	2.097	2.019	1.990	1.963	2.000	2.118-

TABLE 16

12.25-Year Periodic Table of Partridge (Norfolk) Deviations of Logarithms from their 11-year Moving Average.

1792	1.790	1.796	2.034	2.059	2.065	2.172	2.006	2.135	2.040	2.202	1.857	2.099	1.773	
1804	1.773	1.797	1.929	2.042	2.032	2.136	1.965	2.009	1.982	2.177	2.067	2.040	1.561	
1816	1.561	1.973	1.875	1.938	1.999	2.168	2.225	2.139	2.182	2.016	2.114	1.844	1.903	
1829	1.655	1.880	1.823	2.094	2.200	2.115	1.974	2.108	2.050	1.986	1.856	1.977	2.043	
1841	2.043	2.183	1.621	1.953	1.647	2.247	2.024	2.328	2.138	2.162	2.035	2.108	1.587	
1853	1.587	1.927	1.958	2.092	2.281	2.296	1.058	2.235	1.882	2.119	2.110	1.912	1.912	
1866	2.022	2.115	2.140	2.117	2.068	2.082	1.971	1.918	1.657	2.046	2.251	2.115	1.150	
1878	1.150	1.965	2.091	2.041	2.092	2.240	2.324	1.972	2.300	1.558	2.135	1.786	1.869	
1890	1.869	1.847	2.100	1.954	2.084	2.180	2.121	1.916	2.129	1.989	1.880	2.149	1.684	
1902	1.684	2.222	2.514	2.110	2.558	2.059	1.661	1.455	2.082	2.302	2.013	2.334	2.329	
1914	2.329	1.619	1.947	2.269	1.437	1.692	1.862	2.237	2.264	2.543	1.997	2.148	1.181	
1792-1853														
Average Median	1.714	1.862	1.852	2.051	2.049	2.170	1.990	2.132	2.045	2.141	2.051	2.009	1.838	
1853-1914														
Average Median	1.777	1.946	2.096	2.101	2.088	2.131	1.917	1.946	2.106	2.083	2.062	2.132	1.777	
1792-1914														
Average Median	1.749	1.924	1.980	2.064	2.072	2.159	1.985	2.062	2.087	2.109	2.038	2.062	1.775	

TABLE 19

Amplitudes of Cycles as Percent of Trend.

Length of Cycle (Years)	Logarithms of Deviations from Moving Average at High	Logarithms Restored for Amount Retained by Moving Average at High	Percent of Trend at High	Mathematical Representation of "Hunting Year" of first High	Logarithms of Deviations from Moving Average at Low	Logarithms Restored for Amount Retained by Moving Average at Low	Percent of Trend at Low	Mathematical Representation of "Hunting Year" of first Low
22.71	2.165	2.163	145.5	1747.2	1.835	1.837	67.8	1735.9
13.95	2.140	2.123	132.7	1736.0	1.860	1.877	75.3	1729.0
11.84	2.097	2.096	124.7	1738.38	1.903	1.904	80.2	1732.3
8.33	2.061	2.051	113.2	1733.0	1.949	1.946	88.3	1728.0
8.05	2.038	2.040	109.6	1731.5	1.962	1.960	93.3	1727.5
5.09	2.040	2.042	110.2	1728.8	1.960	1.958	90.8	1726.0
4.14	2.032	2.031	107.4	1728.0	1.968	1.969	93.1	1730.07
12.25	2.127	2.142	138.7	1799.5	1.873	1.858	72.2	1794.5

TABLE 18

Partridge Hunting Record on Norfolk Estate.

Year	Number Bagged	Logarithms of Number Bagged	11-Year Moving Average	Deviations from 11-Year Moving Average	12.25-Year Cycle	Residual (Deviations Minus 12.25-Year Cycle
1793	1,349	3.130	3.340	1.790	1.844	1.946
1794	1,433	3,156	3.360	1.796	1.849	1.947
1795	2,594	3.414	3.380	2.034	1.895	2.139
1796	2,814	3.449	3.390	2.059	1.965	2.094
1797	3,800	3.680	3.415	2.065	2.067	2.017
1798	3,965	3.598	3.426	2.172	2.065	2.058
1799	2,895	3.461	3.455	2.006	2.154	1.852
1800	3,865	3.587	3.452	2.135	2.154	1.981
1801	2,908	3.464	3.424	2.040	2.114	1.926
1802	4,036	3.606	3.404	2.202	2.048	2.154
1803	1,721	3.236	3.379	1.857	1.962	1.895
1804	2,831	3.452	3.353	2.099	1.895	2.204
1805	1,320	3.121	3.438	1.773	1.849	1.924
1806	1,296	3.113	3.316	1.797	1.844	1.953
1807	1,686	3.227	3.298	1.929	1.881	2.048
1808	2,024	3.306	3.264	2.042	1.943	2.099
1809	2,050	3.312	3.280	2.032	2.027	2.005
1810	2,516	3.401	3.265	2.136	2.098	2.038
1811	1,748	3.243	3.278	1.965	2.147	1.818
1812	1,811	3.258	3.249	2.009	2.159	1.850
1813	1,707	3.232	3.260	1.982	2.125	1.857
1814	2,588	3.413	3.236	2.177	2.066	2.111
1815	1,967	3.294	3.227	2.067	1.980	2.087
1816	1,894	3.256	3.216	2.040	1.910	2.130
1817	625	2.796	3.235	1.561	1.858	1.703
1818	1,711	3.233	3.260	1.973	1.841	2.132
1819	1,420	3.152	3.277	1.875	1.868	2.007
1820	1,661	3.218	3.280	1.938	1.950	1.988
1821	1,893	3.277	3.278	1.999	2.007	1.992
1822	2,838	3.453	3.285	2.168	2.082	2.086
1823	3,410	3.533	3.308	2.225	2.037	2.188
1824	2,656	3.424	3.295	2.129	2.160	1.969
1825	2,799	3.447	3.265	2.182	2.137	2.045
1826	1,837	3.264	3.248	2.016	2.082	1.934
1827	2,163	3.335	3.221	2.114	2.007	2.107
1828	1,114	3.047	3.203	1.844	1.925	1.919
1829	1,234	3.091	3.188	1.903	1.868	2.035
1830	676	2.830	3.175	1.655	1.841	1.814
1831	1,074	3.031	3.151	1.880	1.858	2.022
1832	954	2.980	3.157	1.823	1.910	1.913
1833	1,773	3.249	3.155	2.095	1.980	2.114
1834	2,343	3.370	3.170	2.200	2.066	2.184
1835	1,925	3.284	3.169	2.115	2.098	1.990
1836	1,492	3.174	3.200	1.974	2.108	1.815
1837	2,138	3.330	3.222	2.108	2.147	1.961
1838	2,056	3.313	3.362	2.050	2.098	1.952
1839	1,649	3.217	3.231	1.986	2.027	1.959
1840	1,115	3.077	3.221	1.856	1.943	1.913
1841	1,485	3.172	3.195	1.977	1.881	2.096
1842	1,900	3.279	3.236	2.043	1.844	2.199
1843	2,676	3.427	3.244	2.183	1.849	2.334
1844	793	2.899	3.278	1.621	1.895	1.726
1845	1,814	3.259	3.306	1.953	1.965	1.988
1846	990	2.996	3.349	1.647	2.048	1.599
1847	4,185	3.622	3.375	2.247	2.114	2.133
1848	2,635	3.421	3.397	2.024	2.154	1.870
1849	4,880	3.688	3.360	2.328	2.154	2.174
1850	3,372	3.528	3.390	2.138	2.114	2.024
1851	3,554	3.551	3.389	2.162	2.048	2.114
1852	2,867	3.457	3.422	2.035	1.962	2.073
1853	3,325	3.522	3.414	2.108	1.895	2.213
1854	1,031	3.013	3.426	1.587	1.849	1.738
1855	1,692	3.228	3.301	1.927	1.844	2.083
1856	1,809	3.257	3.299	1.958	1.881	2.077
1857	2,266	3.355	3.263	2.092	1.943	2.149
1858	3,460	3.539	3.258	2.281	2.027	2.254
1859	3,493	3.543	3.247	2.296	2.098	2.198
1860	210	2.322	3.264	1.058	2.147	0.911
1861	3,130	3.496	3.261	2.159	2.235	2.076
1862	1,437	3.157	3.275	1.882	2.125	1.757
1863	2,562	3.409	3.290	2.119	2.066	2.053
1864	2,505	3.939	3.289	2.110	1.980	2.130
1865	1,567	3.195	3.283	1.912	1.910	2.002
1866	1,997	3.200	3.385	1.815	1.858	1.957
1867	2,555	3.407	3.385	2.022	1.841	2.181
1868	3,308	3.520	3.405	2.115	1,868	2.247
1869	3,385	3.530	3.390	2.140	1.950	2.190
1870	2,996	3.477	3.360	2.117	2.007	2.110
1871	2,772	3.443	3.375	2.068	2.082	1.986
1872	3,108	3.492	3.410	2.082	2.037	2.045
1873	2,426	3.385	3.414	1.971	2.160	1.811
1874	1,742	3.241	3.323	1.918	2.137	1.781
1875	1,167	3.067	3.311	1.756	2.082	1.674
1876	2,317	3.365	3.319	2.046	2.007	2.039
1877	3,828	3.581	3.330	2.251	1.925	2.326
1878	2,841	3.453	3.338	2.115	1.868	2.247
1879	332	2.521	3.371	1.150	1.841	1.309
1880	2,486	3.396	3.431	1.965	1.858	2.107
1881	3,689	3.567	3.476	2.091	1.910	2.181
1882	3,665	3.564	3.523	2.041	1.980	2.061
1883	3,754	3.575	3.483	2.092	2.066	2.026
1884	5,589	3.747	3.507	2.240	2.125	2.115
1885	8,100	3.908	3.584	2.324	2.159	2.165
1886	3,630	3.560	3.588	1.972	2.147	1.825
1887	7,512	3.876	3.576	2.300	2.098	2.202
1888	1,390	3.143	3.585	1.558	2.027	1.531
1889	5,254	3.720	3.585	2.135	1.943	2.192
1890	2,321	3.366	3.580	1.786	1.881	1.905
1891	2,657	3.440	3.571	1.869	1.844	1.825
1892	2,734	3.437	3.590	1.847	1.849	1.998
1893	4,585	3.661	3.561	2.100	1.895	2.206
1894	4,976	3.697	3.613	2.084	2.048	2.036
1895	4,976	3.697	3.613	2.084	2.048	2.036
1896	6,426	3.808	3.628	2.180	2.114	2.066
1897	5,961	3.775	3.654	2.122	2.154	1.967
1898	3,566	3.552	3.636	1.916	2.154	1.762
1899	5,893	3.770	3.641	2.129	2.114	2.015
1900	4,599	3.663	3.674	1.989	2.048	1.941
1901	3,435	4.536	3.656	1.880	1.962	1.918
1902	5,333	3.727	3.578	2.149	1.895	2.254
1903	1,700	3.230	3.546	1.684	1.849	1.835
1904	5,386	3.723	3.501	2.222	1.844	2.378
1905	8,512	3.930	3.416	2.514	1.881	2.633
1906	3,165	3.500	3.390	2.110	1.943	2.167
1907	896	2.952	3.394	1.558	2.027	1.531
1908	2,626	3.419	2.360	2.059	2.098	1.961
1909	1,141	3.057	3.396	1.661	2.147	1.514
1910	694	2.841	3.386	1.455	2.159	1.296
1911	2,388	3.378	3.296	2.082	2.125	1.947
1912	3.800	3.580	3.278	2.302	2.066	2.236
1913	2.243	3.351	3.286	2.334	1.980	2.033
1914	4,166	3.620	3.286	2.334	1.910	2.424
1915	4,138	3.617	3.288	2.329	1.858	2.471
1916	882	2.945	2.326	1.619	1.841	1.778
1917	1,962	3.293	3.346	1.947	1.868	2.079
1918	4,177	3.621	3.352	2.269	1.950	2.319
1919	595	2.842	3.405	1.437	2.007	1.430
1920	1208	3.082	3.390	1.692	2.082	1.610
1921	1,794	3.254	3.392	1.862	2.037	1.825
1922	3,995	3.602	3.365	2.237	2.160	2.077
1923	4,460	3.649	3.385	2.264	2.137	2.127
1924	8,527	3.931	3.388	2.543	2.082	2.461
1925	2,874	3.458	3.461	1.997	2.007	1.990
1926	4,279	3.631	3.483	2.148	1.925	2.223
1927	447	2.650	3.469	1.181	1.868	1.313
1928	3,306	3.519	3.463	2.056	1.841	2.215
1929	4,434	3.647	3.450	2.197	1.858	2.339
1930	4,462	3.650	3.430	2.220	1.910	2.310
1931	2.125	3.327	3.425	1.902	2.028	1.922
1932	1,247	3.096	3.415	1.681	2.066	1.615
1933	3,469	3.540	3.400	2.125	2.140	2.015